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ADVANCED DECOY TECHNOLOGY PROGRAM
ADTECH IV
FINAL REPORT (U)

APPENDIX I, PART II
PROGRAM DESCRIPTION--OPTIMUM DECOY DESIGN PROGRAM

Prepared by

AVCO GOVERNMENT PRODUCTS GROUP
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201 Lowell Street
Wilmington, Massachusetts 01887

AVMSD-0465-68-RR, APP. I
Contract F04701-68-C-0012

June 1969

Sponsored by

Advanced Research Projects Agency
Department of Defense
ARPA Order No. 441, Amendment No. 12

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Prepared for

SPACE AND MISSILE SYSTEMS ORGANIZATION
DEPUTY FOR REENTRY SYSTEMS
AIR FORCE SYSTEMS COMMAND
Norton Air Force Base, California 92409

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SAMSO TR-69-140, APP. I

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R. A. MacFarlane
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UNCLASSIFIED ABSTRACT

(U) This technical report describes analyses and techniques used in the design and evaluation of advanced decoy concepts. The work described addresses both the design of specific penetration aid elements and the formulation of techniques for their evaluation. The three major technical areas covered in this report are:

1. Investigation of a penetration aid technique that degrades the measurement capability of the radar sensor.

2. The design of a computer program to solve the decoy design problem with flexibility in the selection of optimization criteria and constraints.

3. Studies of the use of certain discrimination techniques for a hard point defense system.

This appendix to this report contains detailed description of the optimum decoy design program.

TABLE OF CONTENTS

PART I

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4. Numerical Procedure

First the coefficient counter M and the accumulator ANS are initialized to zero. Then ITP is tested. If ITP is greater than one, statement 10 is executed next, setting NAZU equal to NAX and control then goes to statement 30. In this case, a polynomial in the three unknowns X, Y and Z will be evaluated. If ITP is less than or equal to 1, statement 20 is executed next where NAZU is set equal to 1 and statement 30 is reached. In this case, the polynomial will be a function of only two unknowns X and Y.

At statement 30, the DØ loop ending at statement 130 is entered to perform the calculations needed to evaluate the polynomial. The value of this polynmial is returned to MISC in the variable ANS. When the evaluation is complete, the RETURN statement following 130 is executed, returning control to MISC.

5. Other Information

A. PØLCAL is called by SUBROUTINE MISC only.

B. PØLCAL does not call or reference any other subprogram.

4.0 COMPARISON OF DECOY WITH REENTRY VEHICLE

Comparison of the Decoy with Reentry Vehicle

The comparison of the decoy with the reentry vehicle consists of the evaluations of certain differences and the determination of integrals of special functions. SUBROUTINE F123 performs the difference calculations using SAVEDV to store the values, before calling INTGRL. SUBROUTINE INTGRL evaluates the integrals using in the process FUNCTION ADD, and subroutines INFCOF, INTERP, LINFIT, and WRITEM. F123 also calls in subroutines HEADER AND TIMERS. These integrals include the corridor functions used to constrain the decoy within specified corridors and the effectiveness integrals which are used in the probability of discrimination calculations in SUBROUTINE EFFECT.

SUBRØUTINE F123(XXX)

1. Purpose

F123 can optionally

a. Read the data for a reentry vehicle trajectory from input or call SUBRØUTINE VIXEN to calculate this trajectory data.

b. Call VIXEN to calculate the data for a decoy trajectory.

c. Compare the data for a reentry vehicle trajectory with the data for a decoy trajectory and save tables of differences.

d. Call INTGRL to calculate and plot a corridor integral.

e. Call INTGRL to calculate the sigma square integral to be used by SUBRØUTINE EFFECT.

f. CALL INTGRL to calculate a table of influence coefficients and produce influence coefficient plots at specified altitudes.

2. Input

Name	Common Location	Source of Input	Description
NØTE	The numbers in the Common Location column refer to positions in the ØCCUR array.		
ALST	122	READIT	Stopping value of α envelope, in degrees
CASE	128	READIT	Case number
DATE	127	READIT	Date
DELY	219	READIT	Linear thrust offset along Y axis in inches
DELZ	220	READIT	Linear thrust offset along Z axis in inches
EMØ	129	READIT	Memo number
GAMF0	105	READIT	Initial flight path angle in degrees
GAMMA	028	READIT or SR2490	Ratio of specific heats
LA1	138	READIT	Axial length of initial configuration, in inches
LA2	144	READIT	Axial length of vehicle after shape change at ZTURN, in inches
LP	4000	VIXEN	Error code
MW	117	READIT or SR2490	Molecular weight of air, gram/mole
PHI0	112	READIT	Initial Euler angle Φ, in degrees
PSIZET	223	READIT	Thrust misalignment angle, in degrees
PSI0	114	READIT	Initial Euler angle Ψ, in degrees
RB1	136	READIT	Base radius of inital configuration, in inches

2. Input (cont'd)

Name	Common Location	Source of Input	Description
RB2	142	READIT	Base radius of vehicle after shape change at ZTURN, in inches
RN1	135	READIT	Nose radius of initial configuration, in inches
RN2	141	READIT	Nose radius of vehicle after shape change, at ZTURN, in inches
SIG	116	READIT or SR2490	Collision cross section in angstroms
THEAL0	113	READIT	Initial Euler angle Θ_α , in degrees
THEZET	224	READIT	Thrust misalignment angle in degrees

NØTE Unless otherwise indicated, the entries in the Common Location Column refer to positions in the PCCUR array.

BCB, 40	6181-6220	ZREADX	Array of lower corridor values for ballistic coefficient
BCD, 40	6101-6140	ZREADX	Array of lower corridor values for deceleration in g's
BCV, 40	6021-6060	ZREADX	Array of lower corridor values for velocity in ft/sec.
BCWL1, 40	6501-6540	ZREADX	Array of lower corridor values for wake length in meters for first radar frequency
BCWL2, 40	6581-6620	ZREADX	Array of lower corridor values for wake length in meters for second radar frequency
BCWL3, 40	6661-6700	ZREADX	Array of lower corridor values for wake length in meters for third radar frequency
BCWR1, 40	6261-6300	ZREADX	Array of lower corridor values for wake radar cross section at first radar frequency
BCWR2, 40	6341-6380	ZREADX	Array of lower corridor values for wake radar cross section at second radar frequency

Input (cont'd)

Name	Common Location	Source of Input	Description
BCWR3, 40	6421-6460	ZREADX	Array of lower corridor values for wake radar cross section at third radar frequency
BETAPL, 160	641 - 800	ZREADX or VIXEN	Ballistic coefficients for the input or calculated trajectory points
DVAR, 50	11707-11756	SAVEDV	Array in which design characteristics are saved
DVH, 50	11607-11656	ZREADX	Input values of design variables for the second perturbation of comparison decoy
DVL, 50	11657-11706	ZREADX	Input values of design variables for the first perturbation of comparison decoy
H , 40	5841-5880	ZREADX	Input altitudes corresponding to corridor points, in feet
SB, 40	6821-6860	ZREADX	Standard deviation of radar measurement errors for ballistic coefficient
SD, 40	6781-6820	ZREADX	Standard deviation of radar measurement errors for deceleration in g's
SV, 40	6741-6780	ZREADX	Standard deviation of radar measurement errors for velocity in ft/sec.
SWL1, 40	6981-7020	ZREADX	Standard deviation of radar measurement errors for wake length in meters at first radar frequency
SWL2, 40	7021-7060	ZREADX	Standard deviation of radar measurement errors for wake length in meters at second radar frequency
SWL3, 40	7061-7100	ZREADX	Standard deviation of radar measurement errors for wake length in meters at third radar frequency.

Input (cont'd)

Name	Common Location	Source of Input	Description
TPLØT, 160	1-160	ZREADX or VIXEN	Times for the input or calculated trajectory points in seconds
V0GPLT, 160	481-640	ZREADX or VIXEN	Deceleration in g's for input or calculated trajectory points
VPLØT, 160	321-480	ZREADX or VIXEN	Velocities in ft/sec. for the input or calculated trajectory points
WL1P, 160	1281-1440	ZREADX or VIXEN	Wake length for the first radar frequency input or calculated trajectory points in meters
WL2P, 160	1441-1600	ZREADX or VIXEN	Wake length for the second radar frequency input or calculated trajectory points in meters
WL3P, 160	1601-1760	ZREADX or VIXEN	Wake length for the third radar frequency input or calculated trajectory points in meters
WR1P, 160	801-960	ZREADX or VIXEN	Wake cross section for the first radar frequency for input or calculated trajectory points, see IDBL for units
WR2P, 160	961-1120	ZREADX or VIXEN	Wake cross section for the second radar frequency for input or calculated trajectory points
WR3P, 160	1121-1280	ZREADX or VIXEN	Wake cross section for the third radar frequency for input or calculated trajectory points
WW	------	LINFIT	Coefficient of the independent variable in a linear fit
XX	------	LINFIT	Constant in a linear fit
ZPLØT, 160	161-320	ZREADX or VIXEN	Altitudes for the input or calculated trajectory points, feet

Input (cont'd)

Name	Common Location	Source of Input	Description
SWR1,40	6861-6900	ZREADX	Standard deviation of radar measurement errors for wake cross section at first radar frequency
SWR2,40	6901-6940	ZREADX	Standard deviation of radar measurement errors for wake cross section at second radar frequency
SWR3,40	6941-6980	ZREADX	Standard deviation of radar measurement errors for wake cross section at third radar frequency
TCB,40	6221-6260	ZREADX	Array of upper corridor values for ballistic coefficient
TCD,40	6141-6180	ZREADX	Array of upper corridor values for deceleration in g's
TCV,40	6061-6100	ZREADX	Array of upper corridor values for velocity in ft/sec.
TCWL1,40	6541-6580	ZREADX	Array of upper corridor values for wake length in meters for first radar frequency
TCWL2,40	6621-6660	ZREADX	Array of upper corridor values for wake length in meters for second radar frequency
TCWL3,40	6701-6740	ZREADX	Array of upper corridor values for wake length in meters for third radar frequency
TCWR1,40	6301-6340	ZREADX	Array of upper corridor values for wake radar cross section at first radar frequency
TCWR2,40	6381-6420	ZREADX	Array of upper corridor values for wake radar cross section at second radar frequency
TCWR3,40	6461-6500	ZREADX	Array of upper corridor values for wake radar cross section at third radar frequency

Input (cont'd)

Name	Common Location	Source of Input	Description
*** NØTE*** The following quantities are integers:			
IREF	IØCCUR(301)	ZREADX	Trajectory processing option code, see ZREADX
IØP, 90	IØCCUR(1-90)	ZREADX	Input integer codes, see users manual
LØPT	NØCCUR(07)	READIT	Trajectory option code, see READIT
LPLØT	IØCCUR(302)	ZREADX or VIXEN	Number of points in the input or calculated trajectory
MHEAT	NØCCUR(10)	READIT	Option code for mass loss calculation
MØDE	IØCCUR(303)	ZREADX	Fundamental option code, see ZREADX
MØPT	NØCCUR(03)	READIT	Option code for aerodynamic heating calculation
NCØMDV, 50	IØCCUR(91-140)	ZREADX	Identification code numbers (indices in the ØCCUR array) of design variables to be perturbed under MØDE =2 influence coefficent calculations
NCP	IØCCUR(304)	ZREADX	Number of corridor points
NDECØY	IØCCUR(305)	ZREADX	Vehicle type identification code, see ZREADX
NDVCH	IØCCUR(306)	ZREADX	Number of entries in NCØMDV table, i. e., number of design variables
NØSEØP	NØCCUR(05)	READIT	Option code for noseblunting calculation, see READIT
NTHRST	NØCCUR(22)	READIT	Option code for thrusting, see READIT

3. Output

Name	Common Location	Description
NOTE		Numbers in Common Location Column refer to positions in ØCCUR array for the following quantities:
ALMAX, 200	1044-1243	Maximum in α at the Vixen point altitudes in radius
ALMIN, 200	1244-1443	Minimum in α at the Vixen point altitudes in radius
ALST	122	The stepping control on envelope α, preset to 0.2 degrees
CASE	128	Case number
CDB	99	Base drag coefficient
CDFINF	2793-2800	Skin friction drag coefficient
CDI	100	Induced drag coefficient
CDP	98	Pressure drag coefficient including
CDP0	101	Pressure drag coefficient for zero angle of attack
CM	202	Moment coefficient about c.g., C_m
CN	203	Normal force coefficient, C_n
CØDLAM	94	$7.6489 \times 10^{-9} M_w / \sigma^2$, used in PRELIM to define CØDRAG which is then used in DRAGCØ
CPSZET	216	Cosine of the thrust offset angle ψ_ζ PSIZET
CTHZET	215	Cosine of the thrust offset angle θ_ζ THEZET

Output (cont'd)

Name	Common Location	Description
DECDFP	235	The pressure induced skin friction drag coefficient
DECFTC	236	The transverse curvature induced skin friction drag coefficient
DELCDP	234	The induced pressure drag coefficient
DELY	219	The linear thrust offset component along Y axis, in feet
DELZ	220	Linear thrust offset along Z axis, in feet
FACTR9	197	Numerical factor used in DRAGCØ
FMAX, 200	2244-2443	Frequencies at the altitudes corresponding to ALMAX values, cycles/sec
FMIN, 200	2444-2643	Frequencies at the altitudes corresponding to ALMIN values, cycles/sec
GAMF0	105	Initial flight path angle in radians
LA1	138	See input, in feet
LA2	144	See input, in feet
LP	4000	Error code
MDØT, 32	2708-2739	Distribution along the body of ablative mass loss rates, in lbm/ft^2-sec
MX	210	thrusting moment about X axis
MY	211	thrusting moment about Y axis
MZ	212	thrusting moment about Z axis
OCCUR, 4000	1-4000	Common array

Output (cont'd)

Name	Common Location	Description
PEPSB, 8	2801-2808	Distribution along body of the ratio of edge pressure to stagnation pressure dimensionless
PHI0	112	Euler angle Φ , in radians
PSI0	114	Euler angle Ψ , in radians
QDØT, 32	2676-2707	Distribution along the body of cold wall aerodynamic heating rates
Q0	110	Initial value of the angular rate Q in radians/sec.
RBDØT	60	Time rate of change of base radius due to ablation, ft/sec
RB1	136	See input, in feet
RB2	142	See input, in feet
RNDØT	59	Time rate of change of nose radius due to ablation, ft/sec.
RN1	135	See input, in feet
RN2	141	See input, in feet
SINGO	221	Sine of initial flight path angle
SMR0	111	Initial value of the angular rate R in radians/sec
SPSZET	218	Sine of input PSIZET
STHZET	217	Sine of input THEZET
TAMAX, 200	1444-1643	Times corresponding to maximums in α , in seconds
TAMIN, 200	1644-1843	Times corresponding to minimums in α , in seconds

Output (cont'd)

Name	Common Location	Description
TBMAT, 3	3643-3645	Components of thrust in body axis system, lb
THEAL0	113	Initial Euler angle θ_α , in radians
WDØT	86	Rate of change of vehicle weight due to ablation, lbm/sec
ZMAX, 200	1844-2043	Altitudes corresponding to maximums in α , in feet
ZMIN, 200	2044-2243	Altitudes correspondint to minimums in α , in feet

NØTE Unless otherwise designated, numbers in Common Location column refer to positions in the PCCUR array.

BCB, 40	6181-6220	Array of lower corridor values for ballistic coefficients
BCD, 40	6101-6140	Array of lower corridor values for deceleration in g's
BCV, 40	6021-6060	Array of lower corridor values for velocity in ft/sec
BCWL1, 40	6501-6540	Array of lower corridor values for wake length in meters for first radar frequency
BCWL2, 40	6581-6620	Array of lower corridor values for wake length in meters for second radar frequency
BCWL3, 40	6661-6700	Array of lower corridor values for wake length in meters for third radar frequency
BCWR1, 40	6261-6300	Array of lower corridor values for wake cross section for first radar frequency, see IDBL for units
BCWR2, 40	6341-6380	Array of lower corridor values for wake cross section for second radar frequency, see IDBL for units

Output (cont'd)

Name	Common Location	Description
BCWR3, 40	6421-6460	Array of lower corridor values for wake cross section for third radar frequency
DB, 160	2081-2240	The array of difference between the R/V and decoy ballistic coefficient
DD, 160	1921-2080	The array of difference between the R/V and decoy deceleration in g's
DV, 160	1761-1920	The array of difference between the R/V and decoy velocity in ft/sec
DVAR, 50	11707-11756	Stored values of certain elements of the ØCCUR array
DWL1, 160	2721-2880	The array of difference between the R/V and decoy wake length in meters for first radar frequency
DWL2, 160	2881-3040	The array of difference between the R/V and decoy wake length in meters for second radar frequency
DWL3, 160	3041-3200	The array of difference between the R/V and decoy wake length in meters for third radar frequency
DWR1, 160	2241-2400	The array of difference between the R/V and decoy wake cross section for first radar frequency, see IDBL for units
DWR2, 160	2401-2560	The array of difference between the R/V and decoy wake cross section for second radar frequency, see IDBL for units
DWR3, 160	2561-2720	The array of difference between the R/V and decoy wake cross section for third radar frequency, see IDBL for units
HØLD, 150	7101-7250	A 3 by 50 array of stored design parameters
SAVE, 4320	7251-11570	A 9 by 160 by 3 array of stored differences in design parameters for determining influence coefficients.

Output (cont'd)

Name	Common Location	Description
SB, 40	6821-6860	See input
SD, 40	6781-6820	See input
SV, 40	6741-6780	See input
SWL1, 40	6981-7020	See input
SWL2, 40	7021-7060	See input
SWL3, 40	7061-7100	See input
SWR1, 40	6861-6900	See input
SWR2, 40	6901-6940	See input
SWR3, 40	6941-6980	See input
TCB, 40	6221-6260	See input
TCD, 40	6141-6180	See input
TCV, 40	6061-6100	See input
TCWL1, 40	6541-6580	See input
TCWL2, 40	6621-6740	See input
TCWL3, 40	6701-6740	See input
TCWR1, 40	6301-6340	See input
TCWR2, 40	6381-6420	See input
TCWR3, 40	6461-6500	See input
TT, 200	5561 - 5760	Combined altitude array
TTM, 200	TTMCØM	Combined time array
TS, 160	3201-3360	Array of saved R/V trajectory times

Output (cont'd)

Name	Common Location	Description
TPLØT, 160	1-160	Array of R/V or decoy trajectory times
WL1S, 160	4481-4640	Array of stored wake length values in meters at first radar frequency for reentry vehicle
WL2S, 160	4641-4800	Array of stored wake length values in meters at second radar frequency for reentry vehicle
WL3S, 160	4801-4960	Array of stored wake length values in meters at third radar frequency for reentry vehicle
WR1S, 160	4001-4160	Array of stored values for wake cross section in units specified by IDBL at first radar frequency for reentry vehicle
WR2S, 160	4161-4320	Array of stored values for wake cross section in units specified by IDBL at second radar frequency for reentry vehicle
WR3S, 160	4321-4480	Array of stored values for wake cross section in units specified by IDBL at third radar frequency for reentry vehicle
ZPLØT, 160	161-320	Array of altitudes for R/V or decoy trajectory
ZS, 160	3361-3520	Array of saved altitudes for R/V trajectory
NØTE The following quantities are integers:		
II	IØCCUR(308)	Second subscript of the HØLD array
INALPH	NØCCUR(30)	Option to Input α
JJ	IØCCUR(310)	Second subscript of SAVE array
K	IØCCUR(313)	Number of altitudes in the combined altitude array, TT
LØPT	NØCCUR(07)	Trajectory option code
NCØN	IØCCUR(312)	Location in the ØCCUR array of design parameter being varied

Output (cont'd)

Name	Common Location	Description
NØTE The following quantities are integers (cont'd)		
NDDC0Y	INFTST	Control code used in INTGRL
NGEØM	NØCCUR(15)	Input geometry option code
NLØW	--	A control code used in calling HEADER
NTHRST	NØCCUR(22)	Input thrusting option code

4. Numerical Methods

The following abbreviations will be used:

rvt means reentry vehicle trajectory.

bdt means basic decoy trajectory.

cdt means comparison decoy trajectory.

F123 saves three sets of tables for use by other subroutines. In the first set of tables the values of up to nine characteristics of rvt are saved for each altitude at which SUBRØUTINE VIXEN outputs data. To obtain the second set of tables, the values of the corresponding characteristics for a bdt or a cdt is subtracted from that of the rvt for each characteristic at each altitude. The third table saves up to three sets of these differences in the SAVE array.

In the table below, the first column contains the name of the array in which the values of the characteristic for the rvt are saved. The second column contains the name of the array in which the differences are saved. The third column contains the name of the characteristic whose differences are being saved.

rvt Values	Differences	Characteristic Name
VS	DV	velocity
DS	DD	deceleration
BS	DB	ballistic coefficient
WL1S	DWL1	wake length at radar frequency one
WL2S	DWL2	wake length at radar frequency two
WL3S	DWL3	wake length at radar frequency three
WR1S	DWR1	cross section at radar frequency one
WR2S	DWR2	cross section at radar frequency two
WR3S	DWR3	cross section at radar frequency three

The two statements:- 100 CALL TIMERS(1, TIMTAB)
CALL TIMERS(-1, TIMTAB)

provide for the possibility of printing out the elapsed time between execution of the two statements. In the present deck this subroutine is a dummy producing no output.

After initializing NDC and NDVC, F123 calls SUBRØUTINE SAVEDV to save the values of ØCCUR(133-145), ØCCUR(205-209) and ØCCUR(222) in DVAR(1-19) respectively. These values will be restored to the ØCCUR array later. Next IREF is tested. If IREF is not equal to two go to 497. The transfer to 497 means that the rvt is to be input or calculated when IREF is three or one respectively. If IREF equals two, NDECØY is tested. If NDECØY equals one go to 497. In this case, either a bdt or the rvt is to be processed. If NDECØY equals two, one cdt will be calculated for each design parameter being perturbed. If NDECØY equals three, two cdt's will be calculated for each design parameter being perturbed. If NDECØY is either two or three, the DØ loop ending at 111 is entered to save the values of the design parameters being perturbed. These are saved in the HØLD array. HØLD(1, i) saves the value for the basic decoy. HØLD(2, i) saves the value for the first comparison decoy and HØLD(3, i) saves the value for the second comparison decoy. NDVC is the number of design parameters to be perturbed in one case. The input arrays DVL and DVH contain the perturbed values for the first and second comparison decoys respectively.

At 497, the DØ loop ending at 777 is entered and IREF is tested. If IREF ≠ 2 control passes to 498. Control passes to 401, 402 or 403 when NDECØY

is one, two and three respectively. At each of these three statements the values of NLØW and NHIGH are set and statement 404 is executed next. At 404, NCØN is defined. This is the location in the ØCCUR array of the Ith parameter being perturbed. Next, the call to SAVEDV restores the values saved in DVAR to the ØCCUR array. Then going to 499, NLØW and NHIGH are set for the rvt and 499 follows.

At 499, the DØ loop ending at 444 is entered to obtain and process trajectory data. If KK equals two, ØCCUR(NCØN) is set equal to DVL(II) for the first comparison decoy. If KK equals three, ØCCUR(NCØN) is set equal to DVH(II) for the second comparison decoy. Next, if MØDE is not equal to one, the case number is increased by .001 to aid in identifying printed output and plots. Next, the case, date and memo number are printed and IREF is tested again, and if = 3 passes to 28. The sequence following this test and ending at 56 tests the input options and may reset some of them. The next three set values for numerical constants. The following three set input options equal to storage quantities in order to carry them over to the following input case unless they are reset. The next eight statements change units from inches (input units) to feet (units used internally). The next ten statements set drag coefficient coefficient quantities to zero. Then LØPT is tested. If LØPT equals zero go to 201. If LØPT is not equal to zero, the next nine statements set rotational quantities equal to zero. If LØPT = 0, the quantities related to maximums and minimums in α are zeroed. The next four find the trigonometric functions of the thrust offset angles. The next six change angles from degrees to radians. In the next thirteen, the mass loss and heating quantities are set equal to zero.

The call to TIMERS next prepares to measure the time taken to calculate trajectory. Then VIXEN is called to calculate the trajectory and TIMERS is called twice, the first time to print the time elapsing for the trajectory calculation and the second for the time elapsing between the execution of statement 100 and this call to TIMERS. The following six statements set the thrust quantities equal to zero. The next eight reconvert geometric quantities from feet to inches. Next the value of ALST is changed from degrees to radians and the next three statements set options equal to stored input quantities to prepare for the next case.

Now IREF is tested. If IREF equals two, go to 30. If IREF equals one, the data for the rvt is saved in the DØ loop ending at 22. Then LP is checked. If LP < 6 control passes to 407. If LP equals six, the rvt calculations have failed. A message to this effect is printed, SAVEDV is called to restore values from DVAR to the ØCCUR array, and control returns to the main program.

At 30, HEADER is called to indicate the type of decoy trajectory being calculated and print selected quantities associated with it. Then, in the DØ loop ending at 33, the differences described in the table above are saved. Next LP is tested as above; if equal to 6, a message is written, SAVEDV is called, and the program goes next to 777. If LP is less than 6, control passes to 507.

In the sequence of statements beginning at 507 and ending at 50, the altitudes in the input array H and the altitudes at which VIXEN produces output are combined into one array, monotonically decreasing. If the same altitude is found in both arrays, it is counted only once. The altitude values are put in

the TT array and the corresponding times are saved in the TTM array. The number of elements in each of these arrays is K. Next in the DØ loop ending at 333, the differences needed by the influence coefficients SUBRØUTINE INFCØF are saved. The nine statements between 333 and 444 provide for the calling of SUBRØUTINE INTGRL which may calculate corridor integrals and sigma square integrals as well as call the plotting routine, AVPLT, and the influence coefficients SUBRØUTINE INFCØF. After 777 SAVEDV is called to restore values to the ØCCUR array and control returns to the main program.

5. Other Information

A. F123 is called by the main program.

B. F123 calls

(1) SUBRØUTINE HEADER

(2) SUBRØUTINE INTGRL

(3) SUBRØUTINE SAVEDV

(4) SUBRØUTINE VIXEN

(5) The dummied SUBRØUTINE TIMERS

C. F123 calls the IBM supplied finctions SIN and CØS.

4.1 Integration of Special Functions

SUBROUTINE INTGRL (KA, KB, LX, KD, KE, Q, R, S, SIG, DC)

1. Purpose

INTGRL is intended to perform one of four main tasks depending upon certain input options.

A. To evaluate a corridor integral and print a tabular array of data at each of a number of altitudes.

B. To evaluate a sigma square integral.

C. Call the plot routine to obtain a corridor plot.

D. Call the plot routine to obtain an influence coefficient plot.

2. Input

Name	Source	Common Block	Descrip
A, 27	SR2490 or ZREADX	PCCUR (11571-11597)	See text
B, 40	LINFIT	PCCUR (4961-5000)	See text
C, 40	LINFIT	PCCUR (5001-5040)	See text
D, 160	LINFIT	PCCUR (5041-5200)	See text
E, 160	LINFIT	PCCUR (5201-5360)	See text
F, 40	LINFIT	PCCUR (5361-5400)	See text
G, 40	LINFIT	PCCUR (5401-5440)	See text
H, 40	SR2490 or ZREADX	PCCUR (5841-5880)	Altitude
IØP, 90	ZREADX	IØCCUR (1-90)	Option c
KA	F123		Used to array n
KB	F123		Used to array n
KD	F123		See text
KE	F123		See text
KX	F123	IØCCUR (313)	The num altitudes
LPLØT	VIXEN	IØCCUR (302)	The num altitudes
LX	F123		Flag sp array a integral
NCP	SR2490 or ZREADX	IØCCUR (304)	Number
NDECØY	F123	INFTST	Test pa
ØCCUR, 4000	Unlabeled Common	ØCCUR (1-4000)	

A

lock	Description	Preset
571-11597)	See text	A(I) = 1 If I=1 (MOD3) otherwise A(I)=0
61-5000)	See text	
01-5040)	See text	
41-5200)	See text	
01-5360)	See text	
61-5400)	See text	
01-5440)	See text	
41-5880)	Altitudes at which corridor limits are input	0
-90)	Option code	1
	Used to determine which elements of the IOP array need to be tested	
	Used to determine which elements of the IOP array need to be tested	
	See text	
	See text	
13)	The number of elements in the T array of altitudes	
02)	The number of elements in the Z array of altitudes	
	Flag specifying which three elements of the A array are to be used in evaluating the corridor integral	
04)	Number of elements in the H array	1
	Test parameter for influence coefficient plots	1
-4000)		

B

2. Input (Concl'd)

Name	Source	Common Block	
Q, 40	SR2490 or ZREADX		Array o
R, 160	SR2490 or F123		See Tex
S, 40	SR2490 or ZREADX		Array o
SIG, 40	SR2490		Standard
T, 200	SR2490 or ZREADX	PCCUR (5561 - 5760)	See Tex
TPLØT, 160	VIXEN	PCCUR (1-160)	Array o of altitu
Z, 160	VIXEN	PCCUR (161-320)	Array o data

****
NOTE

DC is a special input of alphanumeric data

A

ock	Description	Preset
	Array of lower corridor limits	0
	See Text	0
	Array of upper corridor limits	0
	Standard deviation in error of measurement	
61 - 5760)	See Text	0
-160)	Array of times corresponding to the Z array of altitudes	
1-320)	Array of altitudes for which VIXEN stores trajectory data	

B

3. Output

Name	Common Block	Description	Preset
A, 27	See Input	See ZREADX for AA	See input
B, 40	See Input	See LINFIT description	
C, 40	See Input	See LINFIT description	
D, 160	See Input	See LINFIT description	
E, 160	See Input	See LINFIT description	
F, 40	See Input	See LINFIT description	
G, 40	See Input	See LINFIT description	
HDIF	PCCUR (11758)	H(1) - H(NCP)	0
OCCUR, 4000	unlabelled common	Some values are changed for use by the optimizer	0
Q1		Lower corridor limit at initial altitude	
Q2		Lower corridor limit at any other altitude.	
R1		Value of R at initial altitude	
R2		Value of R at any other altitude	
S1		Upper corridor limit at initial altitude	
S2		Upper corridor limit at any other altitude	
T, 200	See Input	See text	0
T1		Used by ADD, see Text	
T2		Used by ADD, see Text	
XX, 200		See Text	
YY, 200		See Text	
ZZ, 200		See Text	

4. Numerical Procedures

Before the logical flow in INTGRL is discussed, it will be useful to describe in some detail what we call the corridor integral. The input array H contains a set of altitudes at each of which an upper corridor limit and a lower corridor limit has been input for one or more of nine different arrays. The appropriate set of upper and lower corridor limits are sent to INTGRL through the list in the arrays S and R respectively. The number of elements in each of these arrays is NCP, also an input quantity. The array Z contains the altitudes at which VIXEN outputs trajectory data. The array R contains the difference between the value of some specified characteristics of the reentry vehicle and the value of the same characteristic of a decoy at each of these altitudes. The number of elements in the R and Z arrays is LPLØT, which is defined in VIXEN.

SUBROUTINE LINFIT is used to fit straight line segments between the pairs of points (H(I), Q(I) and H(I+1), Q(I+1)) I = 1, 2, . . . , NCP -1. The coefficients of the fit are saved in the arrays B and C. Similarly, the points (H, S) are fitted and the coefficients saved in the arrays F and G, and the points (Z, R) are fitted and the coefficients saved in the arrays D and E. We can then express the values of Q, R, and S at any altitude ALT by

$$Q = ALT*B(I) + C(I)$$
$$R = ALT*D(I) + E(I)$$
$$S = ALT*F(I) + G(I)$$

The area between the segmented lines formed by Q and R is called the corridor. So long as the value of R is greater than or equal to the value of Q and less than or equal to the value of S, no integration is done.

If R is less than Q on an interval between ALT1 and ALT2 the function $F(Z) = A(LX)*Z^2 + A(LX + 1)*Z + A(LX + 2)$ is integrated over the area defined by lines R, Q, ALT1 and ALT2 with respect to Z and the absolute value of the result is added to DA, the running sum of the integral. If R is greater than S on some interval between the altitudes ALT1 and ALT2, the same function is integrated over the region defined by the lines S, R, ALT1 and ALT2, these two being specific values of Z. The function subprogram ADD is used to perform this integration.

The subroutine flow proceeds as follows: Immediately upon entering INTGRL, IØP(KA + 2*KB) is tested. If IØP(KA + 2*KB) equals 0, no corridor integral calculations are desired and statement 1120 is executed next. If it equals 1, KQ is defined and tested in the next two statements. IF KQ = 1, the heading for the tabular output associated with the corridor integral is printed. The next two statements define JGØ. IF JGØ is 0, the slope print out for the corridor integral will be omitted. LINFIT is then called three times to save the fitting coefficients described above. The next four statements initialize the test parameters NX and ITEST, the accumulator for the corridor integral DA, and the altitude at which R first leaves the corridor DB. Q1, R1, and S1, calculated next, are the respective values of Q, R, and S at the initial altitude Z(1). These values are then saved as XX(1), YY(1), and ZZ(1) for the corridor plots. Next the value of NX is determined. NX will be 0, 1, or 2 depending on whether R1 is less than Q1, between Q1 and S1, or above S1. If Q1 is already outside the corridor, the next two statements will change ITEST to 1 and set DB = Z(1). Then if KQ = 0, statement 40 will be executed next. If KQ = 1, NX is tested and the WRITE statement at 10, 30, or 20 will be executed to write the first line of the corridor integral table as NX is 0, 1, or 2 respectively. Then statement 40 is executed.

Following the statement 40, NS and NR are defined and the DØ loop ending at 1111 is entered to calculate the corridor integral.

The array T, used here, was generated in F123 by combining the H and Z arrays. If an element is common to both arrays, it is included in the T array only once. The T, H, and Z arrays are monotonically decreasing. It will usually happen that for some J, T(M) will lie between H(J) and H(J+1). If so, the value of J is found and saved in the DØ loop ending at 44. If not, J is set equal to NR. Similarly, it will usually happen that T(M) lies between Z(I) and Z(I+1) for some I. If so, the value of I is found and saved in the DØ loop ending at 55. Otherwise I is set = NS.

The six statements starting at 60 set Q2, R2, and S2 equal to the values of Q, R, and S respectively at the altitude T(M) and then save these values in XX(M), YY(M) and ZZ(M) respectively. The next three statements find the value of NY which will be 1, 4, or 7 accordingly as R2 is less than Q2, between Q2 and S2, or greater than S2. NX and NY now describe the behavior of the R line between the altitudes T(M-1) and T(M). IGØ is set = NX + NY and the computed GØ TØ is executed, sending control to the statement having the statement number = 100*IGØ. This transfer will result in the execution of some or all of the following six types of statements.

A. T2, if not = 0, is defined as the altitude at which R crosses either S or Q. It will then be either the higher or the lower of the two altitudes used to define the region of integration.

B. T1 = T(M-1).

T1, when used is the higher altitude defining a region of integration.

C. DA = DA + ADD

The function subprogram ADD performs the integration and adds the result to DA.

D. CALL WRITEM

If KQ = 1, a line of output is printed in the corridor integral table for the altitude T(M).

E. IF ITEST = 0, GØ TØ 950

If ITEST = 0, statement 950 is executed next. If not, the following statement is executed.

F. GØ TØ 999

Statement 999 is executed next.

A description of the region of integration at each of the statements 100, 200, ... 900 follows. The following notation is used in the description The general form is at XXX L1, L2, L3, L4, L5, where XXX is the statement number, L1 is the lower line of the region of integration which may be either a triangle or a trapezoid; it is always either R or S. L2 is the upper line for the region; it is always Q or R. L3 is the higher of the two altitudes defining the region and L4 is the lower altitude. L3 and L4 are parallel. L5 may be any of the four RQB, RSA, RQI and RSI meaning respectively R crosses Q from below lower corridor, R crosses S from above upper corridor, R crosses Q from inside corridor, and R crosses S from inside corridor. If there is no crossing, L5 is omitted.

At 100 the lines R, Q. T1, T2 define the region of integration.

At 200, R, Q, T2, T(M), RQ1 define the region of integration.

At 300, two regions are needed since R goes from above S to below Q. These regions of integration are described respectively by the lines S, R, T1, T2, RSA and by the lines R, Q, T2, T(M), RQI.

At 400, R, Q, T1, T2, RQB describe the region of integration.

At 500, no integration is required. R is between Q and S for the entire interval.

At 600, S, R, T1, T2, RSA describe the region of integration.

At 700, two regions are required since R goes from below Q to above S. These regions of integration are described respectively by the lines R, Q, T1, T2, RQB and by the lines S, R, T2, T(M), RSI.

At 800, S, R, T2, T(M), RSI define the region of integration.

At 900, S, R, T1, T(M), RSI define the region of integration.

At statement 950, ITEST is changed to 1, then DB is set = T2 and statement 999 is executed.

At 999, NX is redefined to specify the relation of the beginning of the next R line segment to the corridor.

After statement 1111 has been executed KX-1 times, DA and DB are put into the OCCUR array for possible use by the optimizer. Next, if KQ = 0, the values of DA and DB are printed along with the name of the variable in the R array.

Next, IØP(KA + KB) is tested. If it equals 0, statement 2300 is executed. If it equals 1, we compute the sigma square integral. We use the trapezoidal rule to integrate the function $(R/SIG)^2$ from H(1) to H(I+ 1) I = 1, 2, . . . , NCP-1 with respect to H. The running sum is kept in the variable SUM. The values of SIG are input in the SRS array. As a preliminary RLØ is set = $[R(1)/SIG(1)]^2$ and SUM is set = 0. The values of R at the altitudes H(2), H(3), . . . H(NCP) are found by linear interpolation in

the DØ loop ending at 2222. SUBROUTINE INTERP finds these values. RHI is defined as $(R(I)/SIG(I))^2$. The value of the integral from H(I-1) to H(I) is computed and added to SUM. RLØ is then set equal to RHI and the loop executed again. SUM is then put into the OCCUR array for possible use by the optimizer. Next IØP(KA) is tested. If it equals 0, statement 4000 is executed. If it equals 1, AVPLT is called to produce a corridor plot.

At 4000, if NDECOY is less than 3, control returns to F123. If it equals 3, IØP (KA + 5*KB) is tested. If it equals 1, AVPLT is called to produce an influence coefficient plot and control returns to F123. If it is equals 0 control returns to F123 immediately.

5. **Other Information**

A. INTGRL is called by F123 only

B. INTGRL calls

1. SUBROUTINE LINFIT
2. SUBROUTINE WRITEM
3. SUBROUTINE INTERP
4. SUBROUTINE AVPLT
5. FUNCTION ADD

FUNCTION ADD (L,R, S, A, B, C, D, E)

1. Purpose

Add evaluates $\int_R^S F(t)\,dt$ over a trapezoidal region in the t, y plane defined as the area enclosed by the four lines:

1. $t = R$
2. $t = S$
3. $y = A*t + B$
4. $y = C*t + D$

$$F(t) = E_L t^2 + E_{L+1} t + E_{L+2}$$

2. Input

Name	Source	Description
A	INTGRL	curve fit coefficient
B	INTGRL	curve fit coefficient
C	INTGRL	curve fit coefficient
D	INTGRL	curve fit coefficient
E	INTGRL	AA, weighting coefficients for corridor integrals, 11571-11597
L	INTGRL	integer indicating which AA's are to be used
R	INTGRL	altitudes in feet
S	INTGRL	altitudes in feet

The E array is input under the name AA. It reached SUBROUTINE INTGRL through the PCCUR common array and INTGRL then sends it to ADD through the argument list.

E(3), E(6), E(9), E(12), E(15), E(18), E(21), E(24), and E(27) are preset to 1.0 and the rest of the E array is preset to zero in subroutine SR2490. R and S are altitudes in feet.

3. Output

Name	Description
ADD	corridor integral increment

4. Numerical Procedure

Since the height of the trapezoid is(C-A) * t + (D-B), we may write

$$ADD = \int_R^S F(t)*((C-A)*t + (D-B))*dt.$$

This can be integrated explicitly as a function of t to give the integral I.

$$I = (C-A)\left(E_L \frac{t^4}{4} + E_{L+1} \frac{t^3}{3} + E_{L+2} \frac{t^2}{2}\right) + (D-B)\left(E_L \frac{t^3}{3} + E_{L+1} \frac{t^2}{2} + E_{L+2}\, t\right)$$

The value of I at t = R is subtracted from its value at t = S and the result is placed in location ADD.

5. Other Information

FUNCTION ADD is called by SUBROUTINE INTEGRAL only. FUNCTION ADD does not call or reference any subprogram.

SUBROUTINE INFCØF (DC, IZ, ZQ)

1. Purpose

SUBROUTINE INFCØF calculates a table of influence coefficients and possibly second derivatives, at each altitude for which VIXEN stores trajectory information

2. Input

*indicates integer quantity

Name	Common Block	Source	Description
DC, 2	-	INTGRL	name of delta
H, 150	PCCUR(7101-7250)	F123	holds design variable values
II	IØCCUR(308)*	F123	second subscript of H
IZ, 19	-	INTGRL	locations, in ØCCUR array, of 19 special parameters
JJ	IØCCUR(310) *	F123	first subscript of SAVE
LPLØT	IØCCUR(302) *	VIXEN	number of output altitudes
NCØN	IØCCUR(312) *	F123	location in the ØCCUR array of design parameter being varied
NDECØY	IØCCUR(305) *	SR2490, ZREADX	test parameter
S, 4320	PCCUR(7251-11570)	F123	array of saved deltas
T, 160	PCCUR(1-160)	VIXEN	time array
XQ, 40	-	INTGRL	array containing design parameter names
Z, 160	PCCUR(161-320)	VIXEN	altitude array

3. Output

SUBROUTINE INFCØF produces only printed output.

4. Numerical Procedure

The following definitions help to explain the meaning of the influence coefficients and the second derivative and the method of calculating them. The three deltas which may be printed out at each altitude are

First delta equals S(JJ, I, 1)

Second delta equals S(JJ, I, 2)

Third delta equals S(JJ, I, 3)

The array called S here is called SAVE in F123 which produces it. The first subscript, JJ, specifies the appropriate of the nine possible vehicle characteristics for which deltas have been saved. The second subscript, I, indicates the altitude at which the deltas were computed. The third subscript is 1, 2, or 3, when the decoy being compared with the reentry vehicle is respectively a basic decoy, a first comparison decoy and a second comparison decy.

First influence coefficient equals

$$\frac{S(JJ, I, 2) - S(JJ, I, 1)}{H(2, II) - H(1, II)}$$

Second influence coefficient equals

$$\frac{S(JJ, I, 3) - S(JJ, I, 1)}{H(3, II) - H(1, II)}$$

The array called H here is called HØLD in F123 where it is generated. The subscript II comes from F123 and specifies which design parameter is being perturbed. The first subscript of H has the same meaning as the third subscript of S above.

Second derivative equals (second influence coefficient minus first influence coefficient) / (H(3, II) minus H(2, II))

The flow proceeds as follows: The DØ loop ending at 11 tests to determine if the design parameter being perturbed is one of the nineteen for which names have been stored in the XQ array. If so, JP specifies which of these names will be printed as part of the table identification. Otherwise, JP is set equal to zero and the value of the integer NCØN is printed instead. Next X21, the difference in H, is defined to be used in calculating the first influence coefficient. Then, if NDECØY equals two, statement 100 is executed next. If NDECØY equals 3, X32, the difference in H, is defined to be used for calculating the second influence coefficient and X31 is defined to be used in calculating the second derivative.

At 100 AMID is defined as the arithmetic average of H(1, II) and H(2, II) for print out. Some preliminary information is printed, then a table heading having the five columns: ALTITUDE, TIME, FIRST DELTA, SECOND DELTA, INFLUENCE COEF is written. In the DØ loop ending at 222 one influence coefficient is calculated at each altitude and a line of five numbers is printed out at each altitude. The control returns to INTGRL.

At 500, the procedure is quite similar. The three arithmetic averages AMID, BMID and CMID are computed for preliminary print out. The table heading this time has eight columns: ALTITUDE, TIME, FIRST DELTA, SECOND DELTA, THIRD DELTA, FIRST INFLU COEF, SECOND INFLU COEF, SECOND DERIV.

In the DØ loop ending at 555, two influence coefficients and a second derivative are computed at each altitude and the eight specified values are printed under the appropriate headings. Then control returns to INTGRL.

5. <u>Other Information</u>

A. INFCØF is called by INTGRL only.

B. INFCØF does not call or reference any other subprogram.

SUBROUTINE INTERP (M, N, W, X, Y, Z)

1. Purpose

Given the two tables X and Y(X) and, in addition, a particular value of X, called W, SUBROUTINE INTERP finds Z equal to Y(W) by linear interpolation.

2. Input

Name	Source	Description
M	WAKE	dimension of X and Y arrays in WAKE
N	WAKE	size of X and Y tables
W	WAKE	particular value of X
X	WAKE	table of independent variables
Y	WAKE	table of dependent variables

3. Output

Name	Description
Z	value of Y(W) found by linear interpolation

4. Numerical Procedure:

First N is tested to determine if it is greater than zero and less than or equal to M. If it is, statement 20 is executed. If it is not, an error message is printed and SUBROUTINE EXIT is called to terminate the computer run.

At statement 20 X(1) is compared with X(2) to determine whether the X array is increasing or decreasing. The X array must be either monotonically increasing or monotonically decreasing. If it is not, results will be unreliable. If X(1) is less than X(2) control is transferred to statement 50 and the value of I, such that W is between X(I-1) and X(I), is found. If W is outside the range of the X table, I will be either 2 or N, accordingly as W is less than X(1) or greater than X(N) respectively. The value of Z is then computed at statement 40. If X(1) is greater than X(2), the value of I is found in the DØ loop ending at 22 and Z is again calculated at statement 40.

5. Other Information

A. SUBROUTINE INTERP is called by SUBROUTINE WAKE.

B. SUBROUTINE INTERP calls the IBM SUBROUTINE EXIT.

SUBROUTINE LINFIT (ND, NENTRY, X, Y, A, B)

1. Purpose

Given the NENTRY points (X, Y), LINFIT finds the equation of the line passing through the points (X, Y), (X_i, Y_i), in the form $y = A_i x + B_i$, for i = 1, 2, ..., (NENTRY-1). These coefficients can then be used by the calling program for making a linear fit when the interval required is known in advance.

2. Input

Name	Source	Description
ND	F123 and/or INTGRL	adjustable dimension
NENTRY	F123 and/or INTGRL	number of elements in X, Y, A and B
X, ND	F123 and/or INTGRL	array of independent variables
Y, ND	F123 and/or INTGRL	array of dependent variables

3. Output

Name	Symbol	Description
A, ND	A_i	coefficient of X in linear fit
B, ND	B_i	constant in linear fit

4. Numerical Procedure

$A_i = (y_{i+1} - y_i)/(x_{i+1} - x_i)$ and $B_i = y_i - A_i\ x_i$ are the equations

evaluated by SUBROUTINE LINFIT.

5. Other Information

A. LINFIT is called by SUBROUTINE INTGRL and by SUBROUTINE F123.

B. It does not call or reference any other subprogram.

SUBROUTINE WRITEM(IX, Z, T, Q, R, S, DA, DB, SLØPE, N)

1. Purpose

Each time SUBROUTINE WRITEM is called, a single line may be printed in the corridor integral table.

2. Input

The source of all input quantities is SUBROUTINE INTGRL

*indicates integer quantity

Name	Description
DA	cumulative value of the integral
DB	altitude at which delta enters or leaves corridor
IX*	test parameter for the write statement to be used
N*	control code; if N equals zero, print out is deleted
Q	lower corridor value at altitude Z
R	value of delta at altitude Z
S	upper corridor value at altitude Z
SLØPE	slope of delta on latest line segment
T	time at altitude Z
Z	altitude

3. Output

Only printed output is produced as described in Section 4.

4. Numerical Methods

First N is tested. If N equals zero, no printing is done and control returns to INTGRL. Otherwise, IX is divided by ten so that it can be used as the index of a computed go to statement.

Control is then transferred to 10, 20, 30, 40, 50, or 60 when IX is 1, 2, 3, 4, 5, or 6 respectively. At each of the six write statements at 10, 20, 30, 40, 50, and 60, the first six columns of the integral table are filled. These contain the values of altitude, time, lower corridor, delta, upper corridor and integral value. At 20, the leave corridor column is also filled. At 30, the enter corridor column is filled. At 40, the slope column is filled. At 50, both the leave corridor and slope columns are filled. At 60, both the enter corridor and slope columns are filled. After the line has been printed, control returns to INTGRL.

5. Other Information

A. SUBROUTINE WRITEM is called by SUBROUTINE INTGRL only.

B. SUBROUTINE WRITEM calls no other subprograms.

4.2 Storage of Geometric Parameters

SUBROUTINE SAVEDV(K, DVAR, ∅CCUR)

1. Purpose

SAVEDV stores the values of ∅CCUR(133-145), ∅CCUR(205-209) and ∅CCUR(222) in DVAR(1-19) respectively and later restores these values to the ∅CCUR array.

2. Input

*indicates integer quantity

Name	Source of Input	Description
DVAR, 50	F123	array to save selected ∅CCUR values
K *	F123	test parameter
∅CCUR, 4000	F123	common array

3. Output

Name	Description
DVAR, 50	See Input
∅CCUR, 4000	See Input

4. Numerical Procedures

If the input test parameter K is one, statement 100 is executed. If K is two, statement 200 is executed.

A 100 the values of ∅CCUR(133-145), ∅CCUR(205-209) and ∅CCUR(222) are saved as DVAR(1-19) respectively and control returns to F123.

At statement 200 the values stored in the DVAR array at statement 100 are restored to the appropriate locations in the OCCUR array and control returns to F123.

5. Other Information

A. SAVEDV is called by F123 only.

B. SAVEDV does not call or reference any other subprograms.

4.3 Miscellaneous Printout Operations

SUBROUTINE HEADER(K)

1. Purpose

HEADER prints the type of vehicle whose trajectory is being processed along with the values of nineteen design parameters, the value of NGEØM, an input option,and the value of LP an error test parameter.

2. Input

Name	Source	Common Block	Description
K	F123		test parameter
NØCCUR, 30	READIT	NØCCUR	input options
ØCCUR, 4000		ØCCUR	common array

3. Output

SUBROUTINE HEADER produces printed output only.

4. Numerical Procedure

Immediately upon entering HEADER, K is tested. The statements 10, 20 and 30 are executed next when K is 1, 2, and 3 respectively.

At 10 the heading "BASIC DECOY TRAJECTORY" is printed and control is transferred to 40.

At 20 the heading "COMPARISON DECOY CHARACTERISTICS" is printed and control is transferred to 40.

At 30 the heading "REFERENCE REENTRY VEHICLE CHARACTERISTICS" is printed and statement 40 follows.

At 40 the values of nineteen design parameters, the option NGEØM and the test parameter LP are printed with appropriate headings. Then control returns to F123.

5. Other Information

   A. HEADER is called by F123 only.

   B. HEADER does not call or reference any subprograms.

SUBROUTINE TIMERS

1. Purpose

SUBROUTINE TIMERS is a dummy subroutine.

2. Input

None

3. Output

None

4. Numerical Procedure

The original TIMERS has the facility to print the time elapsing between the execution of any two specified statements in a subroutine. It has been replaced by the dummy because this print out is not desired at present.

5. Other Information

A. SUBROUTINE TIMERS is called by F123 only.

B. SUBROUTINE TIMES does not call or reference any other subprogram.

5.0 EFFECTIVENESS OPERATIONS

Effectiveness Operations

The implementation of the decoy effectiveness model technology is contained in SUBROUTINE EFFECT.

SUBROUTINE EFFECT

1. Purpose

SUBROUTINE EFFECT calculates quantity PD which is the probability that a decoy will be discriminated. SUBROUTINE EFFECT receives from input a quantity PFD (the probability of false dismissal of a reentry vehicle and calculates a quantity SIGMA. Next T is found such that

$$PFD = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{T} e^{-\frac{x^2}{2}} dx$$

This is done by a Newton-Raphson iteration scheme. Finally PD is calculated as

$$PD = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{T + SIGMA} e^{-\frac{x^2}{2}} dx$$

2. Input

Name	Source	Common Block	Preset	Description
IØP, 90	SR2490, ZREADX	IOCCUR(1-90)	1	option parameter
HDIF	INTGRL	PCCUR(11758)	0	total length of corridor
PFD	SR2490, ZREADX	PCCUR(11757)	0	probability of false dismissal
SRS, 9	SR2490, ZREADX	PCCUR(11598-11606)	0	number of smooth radar samples

3. Output

Name	Common Block	Description
PD	ØCCUR (3962)	probability of discrimination
SIGMA	ØCCUR (3965)	The sum of nine weighted squares divided by HDIF. SIGMA equals the square root of the quotient

4. Numerical Procedure

The DØ loop ending at 11 accumulates the sum of nine weighted squares. Then the two statements following 11 divide this sum by HDIF and set SIGMA equal to the square root of the quotient. TØLD is set equal to -2 as the initial guess for T. Y is the corresponding value of the integral at this value of T. K is an iteration counter. The IBM function subprogram

$$DERF(T) = \frac{2}{\sqrt{\pi}} \int_0^T e^{-x^2} dx$$

determines the error function used in the integration. If we substitute $X\sqrt{2}$ for X then the desired integral can be expressed as

$$INT = \frac{1}{2} \cdot (1 + DERF(\frac{T}{\sqrt{2}}))$$

The iteration starts at statement 10 where K is increased by 1. If K reaches 20 the program goes to 99 where PD is set equal to one, an error message is written and control returns to FEV.

If convergence is reached, the program goes to 99 where the value of the integral of (T + SIGMA) is calculated and control returns to FEV.

If K is less than 20 and convergence has not been achieved, TØLD and Y are reset and the program goes to 10 to increase K and try again.

5. Other Information

A. SUBROUTINE EFFECT is called by SUBROUTINE FEV.

B. SUBROUTINE EFFECT calls the IBM routines DABS and DERF.

6.0 CLASSIC FUNCTIONS FOR TESTING OPTIMIZATION TECHNIQUES

Classic Functions

The following section contains the description of SUBROUTINE CLASSC, which contains classic functions to be used in testing the optimization procedures.

SUBROUTINE CLASSC (F321)

1. Purpose

SUBROUTINE CLASSC contains classic functions which are designed to provide difficult tests of how well a minimization routine works.

2. Input

*indicates integer quantity

Name	Common Location	Source of Input	Description
A, 514	ØCCUR(301 - 814)	READIT	curve fit coefficients which are read in
IØP	NØCCUR(3)*	READIT	code which determines the function to be minimized; input as MØPT
X, 4000	ØCCUR (1-4000)	FEV	the ØCCUR locations defined in FEV

3. Output

LP	ØCCUR(4000) *		error control code
X, 4000	ØCCUR(1 - 4000)		the output ØCCUR locations correspond to the function value

4. Numerical Procedure

SUBROUTINE CLASSC begins by testing the control code IØP. If IØP equals 3, 4, or 5 control passes to statements 300, 401, or 501 respectively. If IØP has none of these values it evaluates the equation

$$F = 100.\ (X_2 - X_1^{\,2})^2 + (1. - X_1)^2 + A_1$$

then sets X_{100} equal to F. If the absolute value of IØP is 1, control then passes to statement 999. If not, the following equations are evaluated before control passes to 999.

$$B = A_{11} + (X_1 - A_7)\left\{ A_{10} + (X_1 - A_7)\left[A_9 + (X_1 - A_7)\, A_8 \right]\right\}$$

$$C = A_{16} + (X_1 - A_{12})\left\{ A_{15} + (X_1 - A_{12})\left[A_{14} + (X_1 - A_{12})\, A_{13} \right]\right\}$$

$$X_{101} = A_2(X_2 - B)$$

$$X_{102} = A_3(X_2 - C)$$

Statement 300 begins the calculations for another function with the zeroing of the quantities FA, FB, FC, and FD. The quantities FA, FA2, FA3, and FA4 are then evaluated from the equations below and their values assigned respectively to X_{200}, X_{201}, X_{202}, and X_{203}.

$$FA = X_1^2 + X_2^2 + 2.\,X_3^2 + X_4^2 - 5.\,X_1 - 5.\,X_2 - 21.\,X_3 + 7.\,X_4 + A_{17}$$

$$FA2 = 8. + X_4 - X_3 + X_2 - X_1 - X_4^2 - X_3^2 - X_2^2 - X_1^2$$

$$FA3 = 10. + X_4 + X_1 - 2.X_4^2 - X_3^2 - 2.X_2^2 - X_1^2$$

$$FA4 = 5. + X_4 + X_2 - 2.X_1 - 2.X_1^2 - X_2^2 - X_3^2$$

Control then passes to statement 999.

Statement 401 evaluates using the equation below the fourth function whose value is then assigned to X_{300}, before control passes to 999.

$$F = 4.X_1 + X_2 + A_{25}(1./X_1 + 1./X_2) + A_{26}$$

The fifth function is evaluated by statement 501 and its value assigned to X_{400} before statement 999 is reached.

$$F = A_1 X_1^2 + A_2 X_1 X_2 + A_3 X_2^2 + A_4 X_1 + A_5 X_2 + A_6.$$

Statement 999 sets the dummy variable F321 to zero, then LP is set equal to 1 before the return to FEV is executed.

5. Other Information

A. SUBROUTINE CLASSC is called by SUBROUTINE FEV.

B. SUBROUTINE CLASSC calls on the IBM supplied routines IABS and FDXPI (exponentiation).

7.0 PLOTTER INTERFACE SUBROUTINES

Plotting

The subroutines utilizing in plotting, AVPLT, MAXMIN, and PLT are described in the following sections.

SUBROUTINE AVPLT (IZ, XQ, X, Y, Z, KY, IC)

1. Purpose

AVPLT can produce any of four kinds of plots, depending on the value of KY. If KY = 1, influence coefficient plots will be prepared at a specified number of altitudes, NPA. NPA may be a maximum of 160. Three points are plotted on each graph. These points are not connected by straight lines. If KY = 2, one corridor plot is produced. Three curves are plotted on the same graph. The points of each curve are connected by straight lines. If KY = 3, one plot of Y vs. X is produced. The points are connected by straight lines. If KY = 4, one plot of $\log_{10}$ Y vs. X will be produced. The points are connected by straight lines. If KY = 5, the plot file will be closed and the computer run will be terminated.

2. Input

*indicates integer quantity

Name	Source of Input	Common Block	Preset
HØLD, 150	F123	PCCUR (7101-7250)	0
IC *	Calling Program	-	-
II *	F123	IOCCUR (308)	-
IMPLØT *	SR2490	IOCCUR (309)	0
IØP, 90 *	SR2490 or ZREADX	IOCCUR (1-90)	1
IZ, 19 *	Calling Program	-	-
JJ *	F123	IOCCUR (310)	-
KX *	F123	IOCCUR (313)	-
KY *	Calling Program	-	-
LPLØT *	VIXEN	IOCCUR (302)	-
NCØN *	F123	IOCCUR (312)	-
NDECØY *	SR2490 or ZREADX	IOCCUR (305)	1
NPA*	SR2490 or ZREADX	IOCCUR (307)	1
NPV, 160 *	SR2490 or ZREADX	IOCCUR (141-300)	1
SAVE, 4320	F123	PCCUR (7251-11570)	0
T, 200	F123	PCCUR (5561-5760)	0
X	Calling Program	-	-
XQ, 40	Calling Program	-	-
Y	Calling Program	-	-
Z	Calling Program	-	-
ZPLØT, 160	VIXEN	PCCUR (161-320)	0

A

ock	Preset Value	Description
-7250)	0	design variable being perturbed
	-	If KY = 3 or 4, test parameter for log plots. If KY = 1 or 2, contains the vertical axis title.
)	-	Second subscript in HØLD matrix
)	0	Test parameter for opening plot file
0)	1	Option parameter
	-	Array containing plot title information
)	-	First subscript of the variable SAVE
)	-	Number of points for each curve on corridor plot
	-	Test parameter for kind of plot
)	-	Number of altitudes at which information is output from VIXEN.
)	-	Location in ØCCUR array of design parameter being perturbed.
)	1	Test parameter for corridor plot title
)	1	The number of altitudes at which influence coefficient plots are produced.
-300)	1	Array containing indices of altitudes at which influence coefficients flows will be produced.
-11570)	0	Dependent variable for influence coefficient plots.
-5760)	0	Expanded array of altitudes
	-	Dependent variable for all plots except influence coefficient plots
	-	Array containing horizontal axis
	-	Either second dependent variable for corridor plots or dependent variable for third or fourth type of plots
	-	Third dependent variable for corridor plots
320)	0	Array of altitudes at which VIXEN outputs information

B

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3. Output

Name	Common Block	Preset Value	Description
IMPLOT *	IOCCUR (309)	0	Test parameter for opening plot file

4. Numerical Methods

Immediately upon entering AVPLT, the parameter IMPLOT is tested. If IMPLOT = 0, IDFRMV is called to open the plot file. IMPLOT is then changed to 1 and statement 10 is executed. If IMPLOT = 1, statement 10 is executed next.

At statement 10, KY is tested. If KY = 1 or 2, statement 20 is executed. If KY = 3 or 4, control passes to statement 110. If KY = 5, control passes to statement 230 where the plot file will be closed and the computer run terminated. After statement 20, the vertical axis plot title is defined.

Next, in the DØ loop ending at statement 33, the program starts to compare each element of the IZ array with NCØN. If any IZ = NCON, statement 40 is executed next, the required subscript of IZ having been saved as JP. If none of the IZ's = NCON, JP is set to zero, and statement 45 is executed.

At statement 40, JS and Jr are defined. These specify which two elements of the XQ array will be used for the horizontal axis title of an influence coefficient plot or of a corridor plot if a design variable is being perturbed. Statement 45 is executed next.

At statement 45, KY is tested. If KY = 2, statement 70 is executed next. If KY = 1, the three statements following statement 45 define the W array of independent variables which then remain constant for each of the NPA influence coefficient plots to be set up in the DØ loop ending at statement 66. The W's are the three values of the design variable being perturbed. W(1) is the smaller of the two values for the comparison decoys. W(3) is the largest of these two values. W(2) is the value for the basic decoy. The HØLD array values are set in F123 in the DØ loop ending at statement 111. The values in the SAVE array were computed in F123 in the DØ locp ending at statement 33 and then saved in F123 in the DØ loop ending at statement 333. The J defined at the beginning of the DØ loop ending at statement 66 is the index of the altitude at which the values put into the R array were saved. JJ specifies which of the 9 possible arrays of differences is to be used. The statements following the definition of R(3) define the plot titles. Then IOP(76) is tested.

Consequently, if IOP(76) = 1 , the program jumps to statement 60 where the AVCO plot routine EZPLØT is called to set up a plot and then statement 66 is executed. IF IØP(76) = 0, XL, XU, YL, and YU which give necessary scaling information for the Aerospace plotter are calculated. PLT is then called three times to produce a plot and statement 66 is executed next. The statement after 66 returns control to INTGRL. The sequence of statements beginning at 70 and ending just before 110 produce one corridor plot. Three curves are plotted on the same graph, X vs. T, Y vs. T, and Z vs. T. X is the expanded array of lower corridor values. Z is the expanded array of upper corridor values. Y is the expanded array of deltas. These deltas are calculated in F123 in the DØ loop ending at statement 33 and expanded in INTGRL. T is the expanded array of altitudes calculated in F123 in the DØ loop ending at statement 50. XL and XU are respectively the smallest and largest values in the T array. YL is the smallest element

in the X, Y and Z arrays and YU is the largest element in these three arrays. These values are needed by the plotter for scaling purposes. The plot titles are defined next, then at statement 95, IØP(76) is tested. If it is zero, XL, XU, YL, and YU are changed as required for the Aerospace plotter. The 3 calls to PLT are then executed and control is returned to INTGRL. If IOP(76) = 1, statement 100 is executed next, then control return to INTGRL.

The sequence of statements beginning at 110 and ending just before 230 can produce any of 28 possible plots depending upon the meaning of X, Y, KY and IC(1).

If N = 1, a plot of Y vs. X will be produced. If N = 2, a plot of log to the base 10 of Y vs. X will be produced. At statement 110, N is set = 1, then if IC(1) = 0 and KY = 4, N is changed to 2. The DØ loop ending at 111 then tests to determine if all of the Y's are equal. If all the Y's are found to be equal, no plot is produced and control returns to VIXEN. If they are not all equal, statement 120 is executed next. The values of Y are then put into the W array in case it proves necessary to take logs. This will be necessary if the Aerospace plotter is called to produce a log-linear plot. The log if each W is taken in the DØ loop ending at 122 if necessary. Statement 125 and the subsequent write statement put the plot title into the B1 array. Then if IOP (76) = 1, statement 130 is executed calling EZPLOT. Control then returns to VIXEN. If IOP(76) = 0, XL, XU, YL, and YU are calculated, and the Aerospace plotter PLT is called to produce a plot. Control then returns to VIXEN.

The statements beginning at 230 close the appropriate plot file and terminate the computer run.

5. Other Information

A. SUBROUTINE AVPLOT is called by either SUBROUTINE INTGRL or SUBROUTINE VIXEN.

B. SUBROUTINE AVPLT calls the SUBROUTINE MAXMIN.

C. SUBROUTINE AVPLT calls the Aerospace routine PLT and the following AVCO library subroutines:

1. SUBROUTINE IDFRMV
2. SUBROUTINE EZPLØT
3. SUBROUTINE FRAMEV
4. SUBROUTINE ENDJØB
5. SUBROUTINE PLTND

D. SUBROUTINE AVPLT calls the following IBM functions:

1. DMIN1
2. DMAX1
3. DLØG10

E. Statements of the form WRITE(9, XXXX), where XXXX is a format number, place information concerning plot titles on tape 9. This information is read back by statements of the form READ(9, YYYY), where YYYY is a format number.

SUBROUTINE MAXMIN(NTABLE, NDIMEN, X, XMIN, XMAX)

1. Purpose

MAXMIN finds the largest value and the smallest value in the X array containing NTABLE numbers. The smallest value is placed in location XMIN and the largest is placed in location XMAX.

2. Input

Name	Source	Description
NDIMEN	AVPLT	adjustable dimension for X array
NTABLE	AVPLT	number of elements in X array
X, XDIMEN	AVPLT	array of numbers to be searched

3. Output

Name	Description
XMIN	smallest number in the X array
XMAX	largest number in the X array

4. Numerical Procedure

Both XMIN and XMAX are set equal to X_1. Then $X_2, X_3, \ldots X_{NTABLE}$ are compared with XMIN. If any of these numbers is smaller than XMIN, then XMIN is set equal to that X. Parallel to this $X_2, X_3, \ldots X_{NTABLE}$ are being successively compared with XMAX. If any X is greater than XMAX, then XMAX is set equal to this X.

5. Other Information

A. SUBROUTINE MAXMIN is called by AVPLT

B. SUBROUTINE MAXMIN calls no other subroutines or functions.

SUBROUTINE PLT

1. Purpose

SUBROUTINE PLT is a dummy subroutine included so that the calls to the AEROSPACE plotter can be simulated. At AEROSPACE, this should be removed before the deck is compiled or it will replace the AEROSPACE plotter.

2. Input

None

3. Output

None

4. Numerical Procedure

When PLT is entered, control is returned immediately to AVPLT.

5. Other Information

A. SUBROUTINE PLT is called by AVPLT only.

B. SUBROUTINE PLT does not call or reference any othersubprogram.

8.0 LIBRARY SUBROUTINES

8.1 Arc Cosine Function - ACØS (ACØSR, ACØSD)

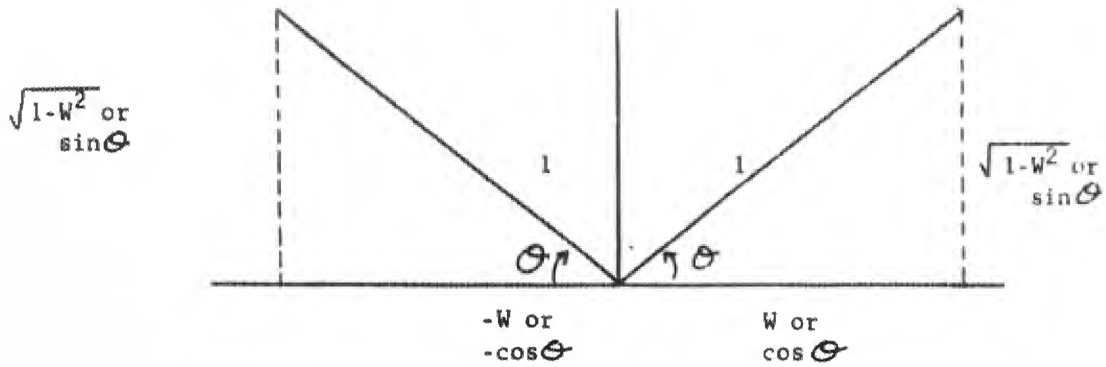
IDENTIFICATION: Arc Cosine Function

USAGE:

X = ACØS(W) X returned in radians
X = ACØSR(W) X returned in radians
X = ACØSD(W) X returned in degrees

In all the above cases, W must be between -1.0 and +1.0. Also, W must be given in REAL*8 and X is returned in REAL*8.

EXPLANATION: (Method)



The arc cosine is computed from the arc tangent i.e.

$$\theta = \arccos(W) = \arctan\left(\frac{\sqrt{1-W^2}}{W}\right)$$

Since $\sqrt{1-W^2}$ is always positive (because the Fortran square root function always returns positive numbers) and W can be positive or negative, the angle returned will be between 0 and π (as shown in the graph).

NOTE: This routine was compiled under ØPT = 2.

8.2 Arc Sine Function - ASIN (ASINR, ASIND)

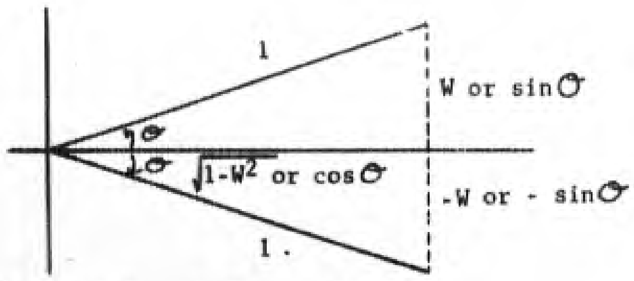
IDENTIFICATION: Arc Sine Function

USAGE:

X = ASIN(W)	X returned in radians
X = ASINR(W)	X returned in radians
X = ASIND(W)	X returned in degrees

In all the above cases W must be between -1.0 and +1.0. Also W must be given as REAL*8 and X is returned as REAL*8.

EXPLANATION: (Method)



The arcsine is computed from the arc tangent, i.e.

$$= \mathrm{ARCSIN}(W) = \mathrm{ARCTAN}\left(\frac{W}{\sqrt{1 - W^2}}\right)$$

Since $\sqrt{1 - W^2}$ is always positive (because the Fortran square root function always returns positive numbers) and W can be positive or negative, the angle returned will be either in the first or fourth quadrant (as shown in the graph). The angles in the fourth quadrant are returned in their positive form because if the angles are negative, they are added to 2π. For example for the angle $-\pi/6$ the answer is returned as $\frac{5\pi}{6}$.

NOTE: This routine was compiled under ØPT = 2.

8.3 Arc Tangent Function - ATANQ (ATANQR, ATANQD)

	Avco CORPORATION research and advanced development division **PROGRAMER'S HANDBOOK**		WRITE-UP NUMBER [illegible]
			PAGE 1 OF [illegible]
PROGRAMER M. DeBolt	MACHINE IBM 360/75	DATE 26 June 1967	BCD NAME ATANQD(Y,X) ATANQ(Y,X), ATANQR([illegible]

IDENTIFICATION: Arc Tangent Function

USAGE:

```
A = ATANQ(Y,X)     A is returned in radians
A = ATANQR(Y,X)    A is returned in radians
A = ATANQD(Y,X)    A is returned in degrees
```

X and Y must both be REAL*8 and the answer A is also returned as a REAL*8. If X and Y are both equal to zero, the program will terminate and an error will be given (IHC265I).

EXPLANATION:

The arc tangent is computed by using the Fortran supplied routine DATAN2, i.e. it finds the angle whose tangent is Y/X (arguments as above). The only difference between these routines (DATAN2 and ATANQ) is that ATANQ always returns the angle in its positive form from 0 to 2 π. It checks to see if an angle is negative and if it is, it is added to 2 π.

NOTE: This routine was compiled under ØPT = 2.

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8.4 FIXIBCØM (MIBCØM) has been dummied out of the program. Originally this routine was a modification of the IBM system routine IBCØM.

8.5 FERRØR has been dummied out of the program. Originally it was related to the error traceback of MIBCOM.

8.6 Variable Field Input Subroutines - LA000000 (WHERE, SETUP, READIN, HEDING)

Language: ØS/360 Fortran IV and B/L

IDENTIFICATION:

Title: Variable Field Input Subroutines

PURPOSE:

To perform the same input operations on OS/360 as BCDCØN/SYMBLS* does on the 7094. These routines are also more flexible in the inputting of subscripted variables.

USAGE:

Calling Sequence:

```
CALL WHERE (TABLE)

CALL SETUP (8HNAME    , L, XY, N1, N2,....)

CALL READIN (INCØIL)

CALL KEDING (NTAPE)
```

Complete description of procedures for proper use of these subroutines:

A. WHERE: This routine is called to inform the routines of the location of a table which will be generated by SETUP and used by READIN. The size of the table must be set by the programmer such that the number of words in the table must be greater than or equal to the number of input variables times seven. The best way to do this is to use the explicit type statement:

REAL* 4 TABLE (ND),

where ND $\geq$ 7 times the number of input variables. WHERE must be called before any of the other routines are, and should never be called more than once.

B. SETUP: This routine is similar to BCDCØN in that it generates a table of 8 character EBCDIC names versus associated core addresses. Variable length information must be included in the argument list and subscript information is included as arguments rather than in a hollerith field, as is the case with BCDCØN. It is

* Reference: Writeup F2-21 of the Programmer's Handbook.

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called once for each variable as follows:

The first argument is the external name of the variable and must have at least eight characters; however, only the first eight characters will be used as the table entry, so any symbols greater than eight characters having their first eight the same will generate the same symbol in the table and only the first one encountered will be effective. If the name has less than eight characters, it must be left adjusted and the eight character field filled with blanks.

The second argument, L, is the length of the variable, in bytes; i.e.

1 for LØGICAL*1,

2 for INTEGER*2,

4 for LOGICAL*4, INTEGER*4, REAL*4,

8 for REAL*8.

The third argument is the internal variable name (i.e., the core location with which the external name is to be associated). This can be subscripted to associate the symbol with core locations other than the beginning of an array.

The remaining arguments are the subscripts. (These are omitted if the variable is not dimensioned). Except for the right most subscript, these must match the dimensions of the variable exactly. The value for the right most subscript need not be correct, but a value <u>must</u> be given in the argument list. The maximum number of subscripts is seven; if more are given, only the first seven will be used. The array length is also somewhat restricted: e.g., if a variable has n subscripts then the product of the left-most (n-1) of them must be less than or equal to 32767. For example, a singly-subscripted variable may have dimension 50000 (say) but a doubly-subscripted variable may not have its first subscript greater than 32767, although its second subscript may be as large as desired.

This routine, unlike BCDCØN and HØLNAM, <u>does</u> distinguish between single-valued variables and one-dimensional arrays. This can be seen by the following:

```
Given:    CALL SETUP (8HX       , 8, X, 10)

          CALL SETUP (8HY       , 8, Y)
```

and the data card: X 5.0 3.0 Y 8.0 6.0, the equivalent Fortran statements are:

X(1) = 5.0

X(2) = 3.0

Y = 8.0

Y = 6.0

Therefore the 8.0 will be overwritten, instead of the 6.0 going into the next double-word location above Y. Incidentally, if Y were subscripted on a data card, READIN would terminate execution with an error message since Y is not supposed to be subscripted.

SETUP may be called anywhere in a program (even in other subroutines) as long as it is called after WHERE has been called and before READIN is called. However SETUP must not be called more than once for any one variable since the calling instructions are not overwritten as BCDCØN does.

The only error is if WHERE is not called before SETUP, in which case SETUP is never executed, and when READIN is called, execution will be terminated with an error message.

C. READIN: This routine reads in the input data (from Fortran Data Set Reference No. 5, so the "data" card is //GØ.FT05F001 DD *), lists the cards on the output tape (FT06F001), obtains the location where the data is to be stored by finding the symbol punched on the card in the SETUP-generated table, converts the data as prescribed, and then stores it into the core location obtained above. This process is continued until a 1-9 punch in column one is encountered, at which point this number is stored in INCØL1, the rest of the card is processed, and control is returned to the calling program.

NOTE: A zero punch in column one will set INCØL1 equal to zero but will not terminate a case. If the routine encounters an E (part of END-ØF-JØB) in column one, execution is terminated immediately by calling EXIT.

Either set of characters (i.e., either the 029 or 026 keypunch) or a combination of both may be used on data cards. However in alphanumeric fields, if EBCDIC characters (such as parentheses, equals, apostrophe) are desired, the 029 keypunch should be used.

The breaking character used to separate items (fields) on the cards is a blank. Therefore the way in which data is presented to the subroutine is completely variable as it appears in columns 2-72, with the exception that a symbol or a piece of data may not be continued from one card to another. The items on a card may be divided into two categories, symbols, and data fields.

1. Symbols. These define core locations and are of two types, name symbol and subscript field.

a) The name symbol is a set of characters, the first eight of which are used to look up the entry in the table generated by SETUP. The name must begin with an alphabetic character (or $) and is terminated by a blank or left parenthesis. From the table entry the base core location, the variable length, and the dimension information is obtained. Execution is terminated with an error message if a symbol is not found in the table.

b) The subscript field, enclosed in parentheses, modifies the core location defined by the last name symbol and sets the addressing increment for successive storing of data. Multiple subscripts in the field are separated by commas, and as with 7094/SYMBLS, blanks may appear anywhere within the parentheses. Data may be stored sequentially (i.e., varying the first, or left most, subscript) or by varying any one of the other subscripts. If the subscripts are not given, the data will be stored <u>sequentially</u> (note this is different from 7094/SYMBLS). If any number of subscripts (less than or equal to the number of subscripts as dimensioned) is given, the data will be stored by varying the right-most subscript (the same as 7094/SYMBLS). However, storing on any one of the subscripts may be forced by putting the subscript number <u>immediately</u> after the right hand parenthesis of the subscript field.

Examples: DIMENSIØN X(4,6,3)

```
1) X 5.0 6.0 8.0
   X(1) 5.0 6.0 8.0
   X(1, 1, 1)1 5.0 6.0 8.0
```

are all equivalent to

```
   X(1, 1, 1) = 5.0
   X(2, 1, 1) = 6.0
```

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X(3, 1, 1) = 8.0

ii) X(1, 1)   5.0 6.0 8.0
X(1, 1, 1)2   5.0 6.0 8.0
are equivalent to

X(1, 1, 1) = 5.0

X(1, 2, 1) = 6.0

X(1, 3, 1) = 8.0

iii) X(1, 1, 1)   5.0 6.0 8.0
X(1, 1, 1)3   5.0 6.0 8.0
or even X(1)3   5.0 6.0 8.0
are equivalent to

X(1, 1, 1) = 5.0

X(1, 1, 2) = 6.0

X(1, 1, 3) = 8.0

This really comes in handy when one wants to store by varying the second subscript (say), starting at some point in the middle of the array. Example: to start at X(3, 2, 2), in 7094/SYMBLS one would have to write X(27,2) since 27 = 4 x 6 x 1 + 3 and must be computed from the dimensions. Now one only needs to write X(3, 2, 2)2

As in 7094/SYMBLS there is a provision for using subscripts to define areas to be set to a value defined by a piece of data which follows. Example:

X(3, 2 - 4, 2)   5.0 is equivalent to

X(3, 2, 2) = 5.0

X(3, 3, 2) = 5.0

X(3, 4, 2) = 5.0

Any one of the subscripts may be of the form K1 - K2 (where K1 < K2). Also, if another data field appears next, it will be stored at the location corresponding to K2 + 1, with the other subscripts the same.

Example: If "6.0" follows "5.0" in the previous example, it will be stored in X(3, 5, 2).

If the number of subscripts on a data card exceeds the number given in the argument list of SETUP for that variable, execution is terminated with an error message.

2. Data Fields. These can be divided into six items:

a) Integers are defined by lack of a decimal point, E, D, or an <u>imbedded</u> plus or minus sign. They can be positive or negative, and a plus is assumed if there is no sign in front. For a length 4 variable the value must not exceed 2147483647 (2^{31} - 1) and if the value exceeds 32767 for an INTEGER*2, the value stored will be modulo 32768. Also one must be careful when reading an integer into a length 8 variable since the second word of the double word will <u>not</u> be zeroed.

b) Floating point numbers are defined by a decimal point in the field. However the decimal point may be omitted if an E or D, or imbedded plus or minus or both appears in the field, as

XXEYY, XX+YY, XXE-YY.

In this case the decimal point is assumed to be just to the left of the exponent field.

The maximum field length to the left of the decimal point is nine digits. Of the total number of digits in the field, only the first sixteen are converted. Any digits after these are ignored until an exponent field (E, D, +, or -) or a field terminator (blank or parenthesis) is encountered. An E, D, +, or - defines the exponent field, and of course the exponent must be integral. Note that E and D are interchangeable since <u>all</u> conversion is done in double precision (only the store depends on the length of the variable). In general, the permissible forms are

±X.XXXXXXXXXXXXXXXEYY

±X.XXXXXXXXXXXXXXXE±YY

±X.XXXXXXXXXXXXXXX±YY

±X.XXXXXXXXXXXXXXX, where there can be one or more X's, there may be either one or two Y's, the decimal point may appear anywhere to the <u>left</u> of the tenth X (measured from the left), and if no sign appears, it is assumed to be positive.

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c) Hexadecimal numbers are input in a manner analogous to the way octal numbers are input by way of 7094/SYMBLS. A Z (or X) in column one of a card signifies to READIN that the card contains only hexadecimal data and nothing else. The data may be read into length 4 or length 8 variables only. A maximum of 8 digits may be read into length 4 variables, and a maximum of 16 digits may be read into length 8 variables. If more than this maximum is given (before a blank), the first 8 (or 16) will be stored correctly, and the digits left over will be right adjusted and stored in the next core location as defined by the last core defining symbol. If less than the maximum is given, the field is right adjusted and stored, and if other than 0 - 9 or A - F appears in the field, execution is terminated with an error message.

d) Alphanumeric data may be defined in three different ways:

i) Hollerith card for HEDING. This type of card has an H in column one. Columns 2 - 80 of this card (not 2 - 72 as with 7094/SYMBLS) will be read into a specially set aside block of storage as Hollerith characters. Nothing else can be done with the card.

ii) Alphanumeric data intended for arrays may be read in using an A-card. There are two cards associated with this option. The first card must have an A in column one, a core location defining symbol and a length of field count anywhere in columns 2 - 72. This count is in units of the length of the variable. For instance, to read 24 characters the length would be 6 for a Real*4 variable and 3 for a Real*8 variable. The second card, which must follow immediately, will contain the alphanumeric data to be stored. The characters on this card, starting in column one will be stored until the length of field is exhausted. The rest of the card is then ignored. If the number of characters as obtained from the A card exceeds 72, execution is terminated with an error message. Example of A-cards:

on the 7094, A TITLE 12 would cause columns 1 - 72 of the next card to be read in. On the 360,

A TITLE 9 (TITLE Real*8)
or
A TITLE 18 (TITLE Real*4)

would also cause columns 1 - 72 of the next card to be read in.

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iii) Alphanumeric data intended for single storage. This type of data has a slash at the beginning of the field, and the first blank encountered terminates the processing of the field. The maximum number of characters is 8 for a length 8 variable and 4 for a length 4 variable. If more than the maximum are given on the card, execution is terminated with an error message. If less than the max are given, the characters defined are left adjusted and the remainder of the word (or double word if Real*8) is filled with blanks. Also, to fill X with blanks, one can use

```
X     /
```

e) Logical data: To input logical data, all that is necessary is to use a decimal point followed by T or F; all characters after this are ignored until a blank is encountered. For instance, the following data cards all will produce the same result

(LØGIC1 = .TRUE.)

```
LØGIC1    .T
LØGIC1    .T.
LØGIC1    .TRUE.
LØGIC1    .TRUEBUTREALLYFALSE
```

One must be careful when reading a logical constant into a length 8 variable, since the second word of the double word will NOT be zeroed.

f) Table generating data. This feature is exactly the same as it is in 7094/SYMBLS. I. e., data may be generated with a minimum of keypunching when numbers are desired ranging from a lower limit to an upper limit in steps of certain given deltas. The format is as follows:

$$X_1(X_2)X_3(X_4)X_5 \text{ , etc.}$$

This will generate from X_1 to X_3 in steps of X_2 ,

X_3 to X_5 in steps of X_4 , etc.

where the X_i may be floating point or integers, but not mixed. There may be as many deltas as desired and they may be positive or negative. There <u>should</u> be no imbedded blanks in the expression, but they are permitted

before a number and after a parenthesis

i.e., $X_1(X_2)X_3$ is permitted.

3. Transfer card. This card will cause return to the calling program after the remainder of the card has been processed. It is signified by a 1 - 9 punch in column 1. Also, this value is stored in INCØL1.

4. End of job card. This card signifies to READIN that there is no more data to be processed, and that the caller wishes to terminate his run. READIN will then transfer control to EXIT.

Internal and External Controls.

A) A * or $ in column 1 will cause the entire card to be ignored (it is printed on the output tape, but NOT on line).

B) There is no *PRINT or *NØPRI option as there is in 7094/SYMBLS. All data cards are automatically printed. There is also no CØMMØN option.

C) There are no external controls.

ERRORS: Execution is terminated immediately with an error message, if

i) SETUP has not been called before READIN.

ii) A name symbol on a data card is not found in the table generated by SETUP.

iii) A field contains an illegal character (such as a decimal point in a subscript field).

iv) A variable is given more subscripts than allowed according to the table. Also, if an error is found, processing is terminated immediately. The rest of the data cards up to the transfer card are not scanned for errors, as is the case with 7094/SYMBLS.

D. HEDING

This routine will write (on NTAPE) the hollerith card read by READIN and eject a page. If an H card was not read in by READIN, the printer will merely restore a page.

The only error is in the case that the Fortran data set reference number (NTAPE) is not defined on a DD card, in which case the result is the same as if one tried to execute a Fortran WRITE with the same number.

Summary

1. No complex variables allowed.

2. Either keypunch may be used.

3. Core storage: $292A_{16}$ bytes or 2635_{10} words.

4. External subroutines used:

   IBCØM#

   FDXPI#

   EXIT

PROGRAMER ... Atkinson, R430
MACHINE OS 360
DATE October 11, 1966
BCD NAME WHERE SETUP READIN HEDING

IDENTIFICATION

Title Variable Field Input Subroutines (Addenda)

USAGE

This write-up is an attempt to clarify some points in the previous write-up (F4-005) and also a discussion of two modifications recently made to READIN

A CLARIFICATIONS Referring to page one of the previous write-up, in the discussion of WHERE ND must be greater than or equal to seven times the number of input variable names ... greater than or equal to seven times the num of calls to SETUP

The first sentence in the fourth paragraph on page two should read "The remaining arguments are the dimensions".

In 7094/SYMBLS a dollar sign anywhere on a data card meant that the rest of the card was a comment This is NOT true for READIN A dollar sign is treated as a letter, except when it appears in column one, in which case the entire card is treated as a comment and ignored

Care should be exercised when calling these routines in a source module which has been compiled under OPT=2 The compiler will invariably compile the module incorrectly unless

1 All input variables are in CØMMØN

2 The module does no arithmetic calculations but instead c lls other subroutines wh h perform the calculations

Therefore unless one (or both) of the above two conditions is satisfied, the programmer should not use OPT=2 for the module which calls SETUP and READIN

B MODIFICATIONS

1 READIN has been modified so that it will treat a comma and an equal sign (from either keypunch) as a field terminator for variable names (symbols), subscript fields, and numerical or logical data. However, only a blank (or end of card) terminates alphanumeric and hexadecimal data. This was done to enable READIN to process NAMELIST data cards. The only changes that need be made to the data cards are:

1) The asterisk (for repeated fields) must be removed since READIN will treat the field as illegal. In lieu of the asterisk the dash may be used in the subscript field as follows

A = 20*0.0 becomes A(1-20)= 0.0,

2) The quotes must be removed from alphanumeric data and a slash (or A-card) used instead, as NAME= 'ALPHA' becomes NAME=/ALPHA

3) Logical data must have a decimal point in front of the T or F.

2 An option of returning control to the calling program after encountering the END-ØF-JØB card has been added. This has been done so that the programmer can regain control in order to close any data sets (such as the plots, by calling PLTND) which would otherwise be closed abnormally by the system. However, the programmer must be extremely careful not to try to read "tape" 5 afterwards. After calling PLTND (or whatever) he merely needs to CALL EXIT.

This option can be exercised if the programmer adds a second argument in the CALL to READIN, which is a non-standard return, and sets INCØL1 (the first argument) to the value 8888 upon first entry to READIN. This is a flag to inform READIN that there is a non-standard return. An example follows:

DATA INCØL1/8888/

CALL SETUP (etc.)

etc

```
1   CALL READIN (INCØL1, $99) [or&99 if EBCDIC]
    [Calculations]
    GØ TØ 1
99  CALL PLTND
    CALL EXIT
    RETURN
    END
```

It should also be mentioned that no changes are necessary to existing programs which do not use this option as long as they do not set INCØL1 to 8888 initially.

IDENTIFICATION:

Title: Variable Field Input Routines (Addenda)

USAGE:

READIN has been completely rewritten in BAL in order to increase efficiency and to save core storage. In the process several modifications have been made.

(1) Special characters are now permitted in the names of variables; only the first character need be alphabetic or a dollar sign. Any special characters, except an equals sign or left parenthesis (either keypunch), may be used.

(2) A blank is now permitted between the E or D and the exponent in floating point data fields. READIN treats the blank as a plus sign. Thus READIN is now able to read cards written by a FORTRAN program.

(3) In logical data fields, . Y and . N (for true and false) are now permitted in addition to . T and . F. Therefore the user can have logical print, punch, plot flags in his program to control the output, as follows:

PRINT .YES PUNCH .NØ PLØT .YES

As with . T and . F, all characters after the Y or N are ignored until a blank or comma (or the end of the card) is encountered.

(4) The suppression of printing of the data cards is now possible by punching NØPRINT in columns 1 through 7. To restore the printing mode, the user punches PRINT in columns 1 through 5. Anything else punched on these cards is ignored. The user does not need to start with a PRINT card since READIN is normally in the printing mode.

(5) READIN normally ejects a page for each case. This may be changed to a line skip for each case by punching NØFLIP in columns 1 through 6. To restore the page ejection mode, the user punches FLIP in columns 1 through 4. The remainder of these cards is ignored by READIN.

(6) The core storage requirement of SETUP/READIN has been reduced to $11BB_{16}$ bytes or 1135 single precision words.

8.7 <u>The dummy subroutines EZPLØT, ENDJØB, FRAMEV, IDFRMV, and PLTND</u> replace the AVCO plotting routines of the same names and must be removed when the program is used at AVCO.

APPENDIX I - Program Listing and Preset Data

```
CMAIN
      IMPLICIT REAL*8 (A-H,O-Z)
C
C
C
C
C        PURPOSE
C
C          MAIN DIRECTS THE CALCULATION OF THE OPTIMUM VALUES FOR THE
C        DESIGN PARAMETERS OF A DECOY.  THE TECHNIQUE USED IS TO
C        MINIMIZE THE DIFFERENCES BETWEEN CERTAIN CHARACTERISTICS OF A
C        REENTRY VEHICLE AND THE  SAME CHARACTERISTICS FOR A DECOY.
C        THE FOLLOWING NINE CHARACTERISTICS MAY BE USED - VELOCITY,
C        DECELERATION, BALLISTIC COEFFICIENT, WAKE LENGTH AT EACH OF
C        THREE RADAR FREQUENCIES AND WAKE CROSS SECTION AT EACH OF THESE
C        FREQUENCIES.   FOUR METHODS FOR FINDING THESE MINIMA ARE
C        (1)  A FIBONACCI ONE VARIABLE SEARCH  (2)  A FIBONACCI TWO
C        VARIABLE SEARCH  (3)  THE DAVIDON METHOD  (4)  THE ROSENBROCK
C        ROTATING COORDINATE METHOD)       A QUANTITY PD, THE PROBABILI-
C        TY THAT A DECOY WILL BE DISCRIMINATED AS BEING A DECOY, CAN
C        ALSO BE DETERMINED.
C
C
C
C
      REAL*4 TAB99(2800)
      COMMON /XXSAVE/ X1SAVE(40), X2SAVE(40), KOUNT
      COMMON/IOPT/IPROC,IN,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON/FOPT/ERR,PRAND, FAC, DELTA
      COMMON/MIN/ALOW(20),UP(20),AMULT(20),CALOW(20),CTP(20)
      COMMON OCCUR, NOCCUR
      COMMON/CCRN/D
      COMMON /IDNOS/ ID1(50), ID2(50)
      COMMON/OWL/OVECT(20),WRF,LRED
      COMMON/BLKJ/ HH(1600),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FO,E, P,TD,RS,SL, Z,Q,A,EL,
     2DELZZ,FAK,C(40,10)
      COMMON/SENSE/ISEN1,ISEN2
      COMMON /NALTFG/FGSM,NALT
      COMMON /CICCUR/ IOCCUR(320)
      COMMON /END/ ITERM
      COMMON/MINSK/N,K, ALB(20), UB(20),XX(20),F1
      COMMON/OOPT/DELX(20)
C
       DIMENSION  IOP(90)
      DIMENSION CUP(20)
      DIMENSION OCCUR(4000), NOCCUR(30)
C
      EQUIVALENCE (NOCCUR(14),NPRINT)
      EQUIVALENCE(OCCUR(4000),LP)
      EQUIVALENCE (IOCCUR(00001), IOP   )
      EQUIVALENCE (IOCCUR(00309), IMPLOT)
      EQUIVALENCE (IOCCUR(00301), IREF  )
      EQUIVALENCE (IOCCUR(00303), MODE  )
C
C
C ITERM IS DEFINED IN FEV
C IF ITERM = -1, FUNCTION = ZERO
C IF ITERM = 0, FUNCTION IS NOT ZERO
```

```
C IF ITERM = 1, FUNCTION IS UNDEFINED.
C
      CALL WHERE(TAB99)
      OCCUR(42)= 3.141592653589793
      CALL SR2490
      CALL ZPRM
      MODE = 3
      P = 0.D0
      D = 0.D0
      DELTA=1.0D0
      FAC=1.0D0
      K=0
      ILL111 = 1
      IMPLOT=0
      LRED = 0
      DO 707 I = 1, 50
      ID1(I) = 0
  707 ID2(I) = 0
C
C
    2 CALL READIT(ILL111,IMPLOT)
      ILL111=2
      IF(MODE-2) 100,110,120
C
  100 IREFS = IREF
      IREF = 1
      IOP(74) = 0
      CALL F123(VAL)
      IREF = IREFS
      GO TO 2
  110 CALL F123(VAL)
      GO TO 2
C
C
  120 IF(IREF.EQ.2) GO TO 5
      CALL F123(VAL)
      GO TO 2
C
    5 IRED = -1
C     SAVE QUANTITIES WHICH CAN BE REDEFINED IN REDUCE
      CTPSAV = CTP(1)
      IY = ID2(1)
      YSAV = OCCUR(IY)
C
C
C           SETUP  INITIAL  STATE
      DO 10I=1,IN
      IZ= ID1(I)
      OCCUR(IZ)=OVECT(I)
      X(I)=OVECT(I)
   10 XX(I)=OVECT(I)
C
   20  GO TO (500,600,700,800,850),IPROC
C
C     SETUP FOR FIBONACCI SEARCH
  500 CONTINUE
      IZMIN= ID1(1)
      CALL MIMAX(ALOW(1), UP(1), 1, -1,ERR, LIMIT, XMIN,YMIN)
      IF(ITERM.EQ.1) GO TO 200
      X(1) = XMIN
```

```
      NPSAVE = NPRINT
      NPRINT = 1
      CALL FEV(IN,X,VAL)
      NPRINT = NPSAVE
      GO TO 900
C
C
  600 CONTINUE
      CALL FEV(IN,XX,VAL)
      GO TO 900
C
C                   SETUP  FOR CAVIDON
  700 CONTINUE
      CALL DAVDON
      IF(ITERM.EQ.1) GO TO 200
      GO TO 900
  800 CONTINUE
C
C SET UP FOR ROSBRK
      CALL ROSBRK
      IF(ITERM.EQ.1) GO TO 200
      NPSAVE = NPRINT
      NPRINT = 1
      CALL FEV(IN,X,VAL)
      NPRINT = NPSAVE
      GO TO 900
C
C
 850  DO 860 I = 1,IN
      ALB(I) = ALOW(I)
      UB(I) = UP(I)
 860  CONTINUE
      KOUNT = 0
      CALL  GIMAX(ALB(2),UB(2),2,-1,ERR,LIMIT,XX(2),VAL)
      IF(ITERM.EQ.1) GO TO 200
      DO 666 I = 1, 40
      IF(XX(2).NE.X2SAVE(I)) GO TO 666
      XX(1) = X1SAVE(I)
      GO TO 870
 666  CONTINUE
      WRITE(6,867)
 867  FORMAT(1H0 50HERROR IN MAIN.  XX(2) UNEQUAL X2SAVE(I) FOR ANY I )
 870  NPSAVE = NPRINT
      NPRINT = 1
      CALL FEV(IN,XX,VAL)
      NPRINT = NPSAVE
      GO TO 900
C
C
C PREPARE TO TIGHTEN CONSTRAINTS.
 900  CALL        REDUCE(CTP,KRED,IRED,LRED,WRF)
      WRITE(6,1100)KRED, ITERM
1100  FORMAT(1H0 'KRED = 'I6, ' ITERM = ' I6)
C
C
        IF(KRED.EQ.0) GO TO 20
C
C     RESTORE SAVED QUANTITIES
 200  CTP(1) = CTPSAV
      OCCUR(IY) = YSAV
```

```
C
      GO TO 2
C
      END
```

```
CADD
      IMPLICIT REAL*8(A-H,O-Z)
      FUNCTION ADD(L,R,S,A,B,C,D,E)
      DIMENSION E(9)
C
C
C          FUNCTION ADD EVALUATES THE INTEGRAL OF F(T) DT FROM R TO S
C        OVER A TRAPEZOIDAL REGION IN THE T,Y PLANE DEFINED AS THE AREA
C        ENCLOSED BY THE FOUR LINES - T=R, T=S, Y=A*T&B, Y=C*T&D.
C        F(T)= E(L)*T**2&E(L&1)*T&E(L&2)
C
C
      BD = D-B
      CA = C-A
      C1 = BD*E(L&2)
      C2 = (CA*E(L&2)&BD*E(L&1))/2.D0
      C3 = (CA*E(L&1)&BD*E(L))/3.D0
      C4 = CA*E(L)/4.D0
      ADD = C1*(S-R)&C2*(S*S-R*R)&C3*(S**3-R**3)&C4*(S**4-R**4)
      RETURN
      END
```

```
CADM4RK
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE ADM4RK(NZ,ZDEL, VALUE, DERN,UPBND,DNBND,FACTOR,FREQ,
     1 HLIMIT,LZ,ZXINDE,DELMIT)
      DIMENSION   ZBAR(70)
     2 DIF(70),  VALUE(70) , DERNN(70) ,DERN(70),
     3DERNM1(70) ,DERNM2(70), DERNM3(70),
     4VALUEN(70)
      DIMENSION  B0(70) , B1(70)
      DIMENSION    UPBND(70) , DNBND(70)
      DIMENSION  SAVD (70)  ,  SAVE (70)
C
C
C         SUBROUTINE ADM4RK PERFORMS THE INTEGRATION OF NZ FIRST ORDER
C        DIFFERENTIAL EQUATIONS OF THE FORM DY(I)/DX EQUALS THE ITH
C        FUNCTION OF (X,Y(1),...,Y(NZ)) FOR VALUES OF I FROM 1 TO NZ BY
C        A FOUR POINT PREDICTOR CORRECTOR METHOD WHICH WILL ALTER THE
C        INTEGRATION INTERVAL TO MAINTAIN A REQUIRED ACCURACY.
C
C
      N=NZ
      L=LZ
      DEL=ZDEL
      XINDEP=ZXINDE
      IF ( DELMIT ) 9002, 9001, 9002
 9001 DELMIT   =   DEL / 1000.0D0
 9002 CONTINUE
C
      IF (L)  1210, 201, 1211
 1210 L= IABS(L)
      GO  TO  23
 1211 GO TO (23,204,204,204,24),L
C
 204  DO 205  JJ = 1,N
      DERN (JJ)  =  SAVD (JJ)
      VALUE (JJ)  =  SAVE (JJ)
 205  CONTINUE
      XINDEP  =  SINDEP
      GO  TO  24
C
 23   XFREQ  =  XINDEP  &  FREQ
      LL = 2
      SAVDEL  =  DEL
      SINDEP  =  XINDEP
      ASSIGN  41  TO  M
      CALL  DEREQ  ( VALUE , XINDEP , DERN  ,  L  )
      IF(L.EQ.6)GO TO 220
      GO  TO 40
C
 24   GO  TO  M, ( 41 , 42 )
 41   DO  62  KK = 1,N
      DERNM3 (KK) = DERN (KK)
 62   CONTINUE
C
      DO  43  NN = 1,3
      W1  =  DEL / 2.0D0
      DO  44   I = 1,N
      B0(I)  =   0.0D0
 44   CONTINUE
```

```
C                                                                 ADM4R 60
      DO  50    J  = 1,4                                          ADM4R 61
      GO  TO  ( 45 , 46 , 48 , 49 ) , J                           ADM4R 62
 45   DIV1  =  6.000                                              ADM4R 63
 47   DIV2  =  2.000                                              ADM4R 64
      H     =  W1                                                 ADM4R 65
      GO  TO  60                                                  ADM4R 66
 46   DIV1  =  3.000                                              ADM4R 67
      GO  TO  47                                                  ADM4R 68
 48   DIV1  =  3.000                                              ADM4R 69
      DIV2  =  1.000                                              ADM4R 70
      H     =  DEL                                                ADM4R 71
      GO  TO  60                                                  ADM4R 72
 49   DIV1  =  6.000                                              ADM4R 73
C                                                                 ADM4R 74
 60   DO  51    I  =  1, N                                        ADM4R 75
      B1(I)  =  DERN(I)  *  DEL                                   ADM4R 76
      B0(I)  =  B0(I)  &  B1(I) / DIV1                            ADM4R 77
      GO   TO  ( 52  , 52  , 52  , 53 ) , J                       ADM4R 78
 52   VALUEN(I)  =  VALUE(I) &  B1(I) / DIV2                      ADM4R 79
      TINDEP     =  XINDEP    &  H                                ADM4R 80
      GO  TO  51                                                  ADM4R 81
 53   VALUEN(I)  =  VALUE(I)  &  B0(I)                            ADM4R 82
 51   CONTINUE                                                    ADM4R 83
 54   CALL  DEREQ  ( VALUEN  , TINDEP  , DERN , L  )              ADM4R 84
      IF(L.EQ.6)GO TO 220                                         ADM4R 85
 50   CONTINUE                                                    ADM4R 86
C                                                                 ADM4R 87
      DO  61    II  =  1,N                                        ADM4R 88
      GO  TO  ( 63, 64, 65 )  ,  NN                               ADM4R 89
   63 DERNM2(II) =  DERN(II)                                      ADM4R 90
      GO  TO  65                                                  ADM4R 91
   64 DERNM1(II)  =  DERN(II)                                     ADM4R 92
   65 VALUE (II) =  VALUEN(II)                                    ADM4R 93
   61 CONTINUE                                                    ADM4R 94
      XINDEP  =  TINDEP                                           ADM4R 95
C                                                                 ADM4R 96
   43 CONTINUE                                                    ADM4R 97
      H1  =  DEL                                                  ADM4R 98
      H2  =  DEL                                                  ADM4R 99
      H3  =  DEL                                                  ADM4R100
      ASSIGN  42  TO  M                                           ADM4R101
      GO  TO  9042                                                ADM4R102
C                                                                 ADM4R103
   42 CONTINUE                                                    ADM4R104
      XFREQ  =  XFREQ  &  FREQ                                    ADM4R105
 9042 CONTINUE                                                    ADM4R106
C                                                                 ADM4R107
      GO  TO  ( 1406, 1407, 1407, 1407, 1207 ) , L                ADM4R108
 1407 IF (ABS( XINDEP - XFREQ ) - ABS( DEL ) ) 1403, 1408, 14060  ADM4R109
14060 IF(ABS(XINDEP-HLIMIT)-ABS(DEL)) 1408,1408,1406              ADM4R110
 1408 CONTINUE                                                    ADM4R111
      DO 1410 IJK  =  1,N                                         ADM4R112
      ZBAR(IJK) = VALUE(IJK)                                      ADM4R113
      DERNN(IJK)  =  DERN(IJK)                                    ADM4R114
      DERN   (IJK)  =  DERNM1 (IJK)                               ADM4R115
      DERNM1 (IJK)  =  DERNM2 (IJK)                               ADM4R116
      DERNM2 (IJK)  =  DERNM3 (IJK)                               ADM4R117
 1410 CONTINUE                                                    ADM4R118
C                                                                 ADM4R119
```

```
      LL  =  1                                                        ADM4R120
 11   TEMP = ABS( XINDEP - XFREQ )                                    ADM4R121
      IF ( TEMP - ABS( DEL ) ) 16, 16, 15                             ADM4R122
 16   L  = 2                                                          ADM4R123
      SINDEP  =  XINDEP                                               ADM4R124
      SAVDEL  =  DEL                                                  ADM4R125
      TEMP1 = ABS( DEL ) / DEL                                        ADM4R126
      DEL  =  TEMP * TEMP1                                            ADM4R127
 15   TEMP = ABS( XINDEP - HLIMIT )                                   ADM4R128
      IF ( TEMP - ABS( DEL ) ) 118, 18, 17                            ADM4R129
 118  L  =  1                                                         ADM4R130
 18   L  =  L & 2                                                     ADM4R131
      SAVDEL  =  DEL                                                  ADM4R132
      TEMP1 = ABS( DEL ) / DEL                                        ADM4R133
      DEL  =  TEMP * TEMP1                                            ADM4R134
 17   GO TO ( 22 , 6 , 6 , 6 , 22)          , L                       ADM4R135
C                                                                     ADM4R136
 1406 CONTINUE                                                        ADM4R137
      LL  =  1                                                        ADM4R138
      L   =  1                                                        ADM4R139
C                                                                     ADM4R140
 1207 CONTINUE                                                        ADM4R141
 12   W1 =  H1 & H2                                                   ADM4R142
      W2 =  W1 * W1                                                   ADM4R143
      W3 =  W1 & H1                                                   ADM4R144
      W4 =  W1 & H3                                                   ADM4R145
      W5 =  W4 & W1                                                   ADM4R146
      W6 =  W4 & W3                                                   ADM4R147
      W7 =  W3 & H3                                                   ADM4R148
      W8 =  W1 * H1                                                   ADM4R149
      W9 =  W1 * H3                                                   ADM4R150
      W10=  H2 & H3                                                   ADM4R151
      W11=  H2 * H3                                                   ADM4R152
      W12=  H1 * H2                                                   ADM4R153
      W16=  W2 & W9                                                   ADM4R154
C                                                                     ADM4R155
      GO  TO  ( 14, 202, 202, 202, 14 ) , L                           ADM4R156
 14   TEMP  =  XINDEP & DEL                                           ADM4R157
      DEL  =  TEMP  -  XINDEP                                         ADM4R158
      IF ( ABS( DEL ) - ABS( DELMIT ) ) 201, 202, 202                 ADM4R159
 201  CONTINUE                                                        ADM4R160
      L  =  6                                                         ADM4R161
      GO TO 4                                                         ADM4R162
C                                                                     ADM4R163
 202  XINDEP  =  XINDEP  &  DEL                                       ADM4R164
      W13=  DEL / 2.0D0                                               ADM4R165
      W14=  W13 * W13 * DEL                                           ADM4R166
      W15=  DEL * DEL / 3.0D0                                         ADM4R167
      W17=  H1 & DEL                                                  ADM4R168
      W18=  W1 & DEL                                                  ADM4R169
      W19=  W1 * DEL                                                  ADM4R170
      W29   =  W3 * DEL                                               ADM4R171
      B0(1)= DEL / W4 * ( W14 & W15 * W6 & W13 * (W2 & 2.0D0 * H1 * W4 &ADM4R172
     X W                                                              ADM4R173
     111) & H1* W16 ) / W8                                            ADM4R174
      B1(1)= -DEL / W10* ( W14 & W15 * W5 & W13 * W16) /W12           ADM4R175
      B2     =  DEL / W1 * ( W14 & W15 * W7 & W13 * H1 * W4)          ADM4R176
     1/W11                                                            ADM4R177
      B3     = -DEL / W4 * ( W14 & W15 * W3 & W13 * W8) /W10          ADM4R178
     1/H3                                                             ADM4R179
```

```
C
      DO 1  I = 1,N
      ZBAR(I) =VALUE(I)&B0(I)*DERN(I)&B1(I)*DERNM1(I)&B2 * DERNM2(I)&B3
     1 *DERNM3(I)
    1 CONTINUE
      CALL  DEREQ  ( ZBAR    , XINDEP , DERNN    , L )
      IF(L.EQ.6)GO TO 220
      A    = (W14 & W15 * W3 & W13 * W8) / W17 / W18
      A0   =-(W14 & W15 * (W3- DEL) & W13*(W8 - W29) -DEL *W8)
     1/W8
      A1   =DEL/W17*(W14& W15 *(W1 -DEL)- W13 * W19 )/W12
      A2   = DEL /W1 * (W14/3.0D0  & H1 * W15 /2.0D0) /H2 / W 18
      DO 13  I= 1,N
      VALUEN(I)=VALUE(I)&A    *DERNN(I)& A0    *DERN(I)&A1    *
     1DERNM1(I)&A2    *DERNM2(I)
      DIF(I) = ABS( VALUEN(I) - ZBAR(I) )
C
      IF  (  DIF(I)  -  UPBND(I) )  13 , 13 , 2
    2 XINDEP  =  XINDEP  - DEL
      DEL    =  DEL   -  FACTOR * DEL
      IF(L-5)7000,14,220
 7000 CONTINUE
      L   =  1
      LL  =  1
      GO TO  14
C
   13 CONTINUE
      IF(L-2)500,5,500
  500 CONTINUE
      H3  =  H2
      H2  =  H1
      H1  =  DEL
      GO TO  ( 11, 5, 5, 5, 22 ) , L
  200 SAVDEL  =  DEL
      GO TO 21
   22 DO 19   K   = 1 ,N
      IF  (  DIF(K)  -  DNBND(K)  )   19 , 19 , 7010
   19 CONTINUE
      DEL  =  DEL & DEL * FACTOR
 7010  IF(L-5)6,200,220
C
 5    CONTINUE
      DO  1040  LLL  = 1,N
      VALUE (LLL) = ZBAR(LLL)
      DERN(LLL) = DERNN(LLL)
 1040 CONTINUE
   21 LL   =  2
C
      GO TO (6,40,40,40,6),L
 6    DO 8  J  =  1,N
      DERNM3(J)  =  DERNM2(J)
      DERNM2(J)  =   DERNM1(J)
      DERNM1(J)  =  DERN  (J)
      DERN(J)  =  DERNN(J)
      VALUE(J)=ZBAR(J)
 8    CONTINUE
   40 CONTINUE
C
      GO TO (212,208,208,208,209),L
  212 CONTINUE
```

```
      GO  TO  ( 1407,  1206  ) , LL
 1206 L  =  2
      GO  TO  206
  208 CONTINUE
      GO  TO  ( 206, 4 ) , LL
  206 CONTINUE
      DO  203  JJJ  =  1,N
      SAVD (JJJ)  =  DERN (JJJ)
      SAVE (JJJ)  =  VALUE (JJJ)
  203 CONTINUE
  209 CONTINUE
C
      GO TO  ( 12 , 4 ),LL
    4 DEL  =  SAVDEL
  220 NZ = N
        LZ = L
        ZDEL = DEL
        ZXINDE= XINDEP
       RETURN
      END
```

```
CAERO
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE AERODY
C
      REAL*8 K1L,K2L,K1T,K2T,K3T,K4T,LA,LA1,LA2,LAMDA,LAPS,MB,MINF
C
      DIMENSION A(514),XLA(8),QDOT(4,8),PEPSB(8),OCCUR(4000),NUCCUR(30)
C
      EQUIVALENCE
     1(OCCUR(010),CAPL  ),(OCCUR(029),HSRT  ),(OCCUR(032),LAMDA ),
     2(OCCUR(033),LA    ),(OCCUR(035),MINF  ),(OCCUR(046),PINFPS),
     3(OCCUR(047),PS    ),(OCCUR(052),RN    ),(OCCUR(055),RHOINF),
     4(OCCUR(064),SINT  ),(OCCUR(069),THETAD),(OCCUR(070),TANT  ),
     5(OCCUR(076),THETA ),(OCCUR(082),V     ),(OCCUR(091),Z     ),
     6(OCCUR(092),ZTR   ),(OCCUR(138),LA1   ),(OCCUR(144),LA2   ),
     7(OCCUR(145),ZTURN ),(OCCUR(189),FACTR1),
     8(OCCUR(0301),    A(1)),(OCCUR(0815),   XLA(1)),
     9(OCCUR(2676),QDOT(1,1)),(OCCUR(2801),PEPSB(1))
C
      COMMON OCCUR,NUCCUR
C
C
C
C         SUBROUTINE AERODY CALCULATES HEATING RATES FOR APPROPRIATE
C      BODY STATIONS.   FOR A SHARP CONE, THESE STATIONS ARE THE
C      STAGNATION POINT AND THE MAXIMUM DIAMETER POINT.   FOR THE
C      BLUNT CONE, THE STAGNATION POINT, SONIC POINT IN TURBULENT
C      FLOW ONLY, TANGENT POINT, THE 20,40,60,75,90 PER CENT STATIONS
C      BASED ON THE INITIAL AXIAL LENGTH, AND THE MAXIMUM DIAMETER
C      POINT - IN ADDITION, SHARP CONE VALUES ARE CALCULATED AT THE
C      MAX. DIAMETER POINT FOR COMPARISON PURPOSES.
C         QDOT(1,1)=STAG. POINT
C         QDOT(2,J)=LAMINAR
C         QDOT(3,J)=TURBULENT
C         QDOT(4,1)=SONIC  POINT
C         J=1  TANGENT POINT  ON BLUNT CONE
C         J=2 THROUGH 7  CORRESPOND  TO THE 20,40,60,75,90 PER CENT
C      STATIONS AND THE MAXIMUM DIAMETER POINT ON THE BLUNT CONE.
C         J=8  MAXIMUM DIAMETER POINT ON THE SHARP CONE OF ANGLE THETA.
C
C
C         CALCULATION OF STAGNATION POINT HEATING RATE
      IF(LAMDA.LT.1.0D-3)RS=1.0D0
      IF(LAMDA.GE.1.0D-3)RS=RN
      QDOTST=1.76D4*SQRT(RHOINF/(.002375D0*RS))*(V/2.604)**3.15D0
      QDOT(1,1)=QDOTST
C
C         SHARP CONE PE/PS AT MAX DIAMETER
      DO 20 J=1,7
   20 PEPSB(J)=0.D0
      XLA(8)=1.0D0
      PEPSB(8)=0.0331D0*EXP(0.0064D0*THETAD-0.33D0*(MINF-5.D0)**0.85D0)
      PEPSB(8)=PEPSB(8)&0.468D-3*THETAD**1.8803200
C
C         BLUNT CONE STATION LOCATIONS
      IF(LAMDA.LT.1.0D-3)GO TO 1
      XLA(1)=RN*(1.D0-SINT)/LA
      IF(Z.GT.ZTURN)DLA=LA1/LA
      IF(Z.LE.ZTURN)DLA=LA2/LA
```

```
      XLA(2)=1.0D0-0.8D0*DLA
      XLA(3)=1.0D0-0.6D0*DLA
      XLA(4)=1.0D0-0.4D0*DLA
      XLA(5)=1.0D0-0.25D0*DLA
      XLA(6)=1.0D0-0.1D0*DLA
      XLA(7)=1.0D0
C
C          QUANTITY  TEST  IS A NON-DIMENSIONAL AXIAL DISTANCE USED IN
C        DETERMINING WHEN FLOW IS CONSIDERED CONICAL
      TEST=1.13D0*RN/(LA*TANT*TANT)
      DO 2 I=1,7
      IF(I.EQ.1)GO TO 16
      IF(XLA(I).LE.XLA(1))GO TO 21
   16 CONTINUE
      IF(XLA(I).GE.TEST)GO TO 3
C
      TEM=LA*TANT*TANT*1.0D4/RN
      XP=0.1740D0*THETAD
      YP=10.D0/MINF
      ZP=0.2D0*DLOG(XLA(I)*TEM)
      WP=0.D0
      IF(THETAD.LT.20.D0)GO TO 13
C          CALCULATION OF BLUNT CONE PRESSURE DISTRIBUTION FOR CONE HALF
C        ANGLE GREATER THAN OR EQUAL TO 20 DEGREES.
      DO 4 N=1,2
      NN=N-1
      ISUB1=41&NN
      TEMN=XP**NN
      DO 4 J=1,3
      JJ=J-1
      ISUB2=ISUB1&2*JJ
      TEMJ=YP**JJ
      DO 4 K=1,3
      KK=K-1
      ISUB=ISUB2&6*KK
    4 WP=WP&A(ISUB)*TEMN*TEMJ*ZP**KK
      GO TO 15
C          CALCULATION OF BLUNT CONE PRESSURE DISTRIBUTION FOR CONE HALF
C        ANGLE LESS THAN 20 DEGREES.
   13 DO 14 N=1,3
      NN=N-1
      ISUB1=135&NN
      TEMN=XP**NN
      DO 14 J=1,3
      JJ=J-1
      ISUB2=ISUB1&3*JJ
      TEMJ=YP**JJ
      DO 14 K=1,3
      KK=K-1
      ISUB=ISUB2&9*KK
   14 WP=WP&A(ISUB)*TEMN*TEMJ*ZP**KK
   15 PEPSB(I)=WP*TANT*TANT&PINFPS
      GO TO 2
   21 XLA(I)=XLA(1)
      PEPSB(I)=0.0D0
      GO TO 2
    3 PEPSB(I)=PEPSB(8)
    2 CONTINUE
C
C
```

```
C         LAMINAR HEATING RATE CALCULATIONS
    1 IF(Z.LT.ZTR)GO TO 5
      QBL=10.D0**(0.5142D0*DLOG(HSRT0)**0.9736D0)
      K1L=0.9664D0&THETAD*(0.00528D0&0.288D-3*THETAD)
      K2L=1.D0&LAMDA*(1.782D0-2.008D0*LAMDA)
      LAPS=LA/PS
      IF(LAMDA.GT.1.D0-3) GO TO 6
C
C         SHARP CONE
      QDOT(2,8)=QBL*SQRT(PEPSB(8)/(2116.D0*LAPS*XLA(8)))/(K1L*K2L)
      RETURN
C
C         BLUNT CONE
C         LAMINAR TANGENT POINT HEATING
    6 QDOT(2,1)=1.7320D0*QDOT(1,1)*(0.007789D0&PEPSB(1)*(1.849D0&PEPSB(1)
     1*(-1.6832D0&0.841D0*PEPSB(1))))
C         LAMINAR HEATING ON CONICAL FRUSTUM
      DO 7 I=2,8
    7 QDOT(2,I)=QBL*SQRT(PEPSB(I)/(2116.D0*LAPS*XLA(I)))/(K1L*K2L)
      RETURN
C
C
C         TURBULENT HEATING RATE CALCULATIONS
    5 QBTC=10.D0**(0.745D0*DLOG(HSRT0)**0.3122D0)
      K1T=0.9D0&0.02D0*THETAD
      K2T=0.6D0
      K3T=0.65D0&LA*(0.0318D0-0.65D-3*LA)
      K4T=1.D0
      IF(LAMDA.GT.1.D0-3)GO TO 8
C
C         SHARP CONE
      TM=PS/2116.D0
      QDOT(3,8)=QBTC*(PEPSB(8)*TM)**0.8D0/(K1T*K2T*K3T*K4T*XLA(8)**0.165
     XD0)
      RETURN
C
C         BLUNT CONE
C         TURBULENT SONIC POINT HEATING
    8 IF(Z.LE.115000.D0)MB=3.45D0
      IF(Z.GT.115000.D0)MB=2.254D0&Z*(2.246D-5&Z*(-146.9D-12&Z*367.1D-18
     X))
      QDOT(4,1)=3760.D0*(RHOINF**0.8D0)*V**MB
      QDOT(4,1)=QDOT(4,1)/((RS**0.2D0)*(FACTR1          )*(10.D0**(4.D0*
     XMB)))
      TM=PS/2116.D0
      QDOT(3,8)=QBTC*(PEPSB(8)*TM)**0.8D0/(K1T*K2T*K3T*K4T*XLA(8)**0.165
     XD0)
C         TURBULENT TANGENT POINT HEATING
      FITANG=(PEPSB(1)**(4.1D0/6.D0))*(1.D0-(PEPSB(1))**(1.D0/6.D0))**0.
     X4D0
      QDOT(3,1)=1.346D4/((RS*(1.D0-THETA))**0.2D0)
      QDOT(3,1)=QDOT(3,1)*((RHOINF/2.375D-3)**0.8D0)*FITANG*(0.0001D0*V)
     X**MB
C         ASSIGNMENT OF APPROPRIATE DENOMINATOR FOR HEATING ON STATIONS
C       AFT OF TANGENT POINT.
      TEST=1.13D0*RN/(3.D0*LA*TANT*TANT)
      K2T=1.0D0
      IF(LAMDA.LE.0.2D0)K2T=0.6D0&2.0D0*LAMDA
      K3T=0.65D0& LA *(0.0318D0-0.65D-3* LA )
      K4T=1.0D0
```

```
      DENOM1=K1T*K2T*K3T*K4T
C     DENOM1 FOR XLA .LE. TEST
      K3T=0.69D0&LA*(0.0318D0-0.69D-3*LA)
      DENOM2=K1T*K2T*K3T
C     DENOM2 FOR XLA .LE. 3.*TEST
      K2T=0.6D0
      K4T=1.0D0
      TEM=LA-RN&RN/SINT
      K3T=0.69D0&TEM*(0.0318D0-0.69D-3*TEM)
      DENOM3=K1T*K2T*K3T*K4T
C     DENOM3 FOR XLA .GT. 3.*TEST
      DO 9 I=2,7
      IF(XLA(I).LE.TEST)GO TO 10
      IF(XLA(I).LE.(3.0D*TEST))GO TO 11
      TM=PS/2116.D0
C          TURBULENT HEATING ON CONICAL FRUSTUM.
      QDOT(3,I)=QBTC*(PEPSB(I)*TM)**0.8D0/(DENOM3            *XLA(I)**0.165
     XD0)
      GO TO 9
   10 DENOM=DENOM1
      GO TO 12
   11 TEM=XLA(I)-TEST
      K4T=0.901D0&TEM*(-0.867D0&0.966D0*TEM)
      DENOM=DENOM2*K4T
      TM=PS/2116.D0
   12 QDOT(3,I)=QBTC*(PEPSB(I)*TM)**0.8D0/(DENOM)
    9 CONTINUE
      RETURN
      END
```

```
CAIM
      SUBROUTINE AIM
         IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/BLKO/ H(40,40),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FC,E, P,TO,RS,SL, Z,Q,A,EL,
     2DELTA,FAC,C(40,10)
      COMMON/BLKI/M,N,L,LS,M1,MS,NS,IT,K,NC
      COMMON /END/ ITERM
C
C
C           SUBROUTINE AIM, PART OF THE DAVIDON MINIMIZATION METHOD,
C         ESTIMATES THE LOCATION OF THE RELATIVE MINIMUM WITHIN THE
C         INTERVAL SELECTED BY SUBROUTINE READY.  THIS LOCATION IS
C         COMPARED WITH THE VALUE THAT WOULD BE EXPECTED FROM A 'PERPEN-
C         DICULAR STEP'.
C
C
  300 Z=GS&GSP&3.0*(F-FP)/EL
  301 TO=GS/Z
      TI=GSP/Z
  302 Q = DSQRT(1.0D0-TO*TI)
      Q = DABS(Q*Z)
      A=(GSP&Q-Z)/(GSP-GS&2.0*Q)
  303 TO=(EL*(GSP&Z&2.0*Q)*A**2)/3.0
  304 FO=FP-TO
  305 CALL MATMP (N,N,H,GP,T)
  306 TP1=GSP/SL
  307 DO 308 I=1,N
  308 T(I)=-T(I)&TP1*S(I)
  309 M=1
  310 CALL MATMP (M,N,T,GP,GTP)
  311 IF (2.0*TO&GTP)317,312,312
  312 TP1=1.0-A
  313 DO 314 I=1,N
  314 T(I)=A*X(I)&TP1*XP(I)
  315 L=1
  316 RETURN
C
C
  317 IF (F&GTP/2.0)312,318,318
  318 DO 319 I=1,N
  319 T(I)=T(I)&XP(I)
  320 M1=2
C
  321 CALL FCN(N,GB,FB,T,M1)
      IF(ITERM.EQ.0) GO TO 322
C
      DO 10 I = 1,N
10    X(I) = T(I)
      GO TO 316
  322 IF (FB-FO)323,312,312
  323 WRITE (6,1)
  324 DO 325 I=1,N
  325 S(I)=T(I)-XP(I)
  326 M=1
  327 CALL MATMP (M,N,S,GB,GTT)
  328 GTT=GTT-GTP
  329 IF (GTT)335,330,330
C
```

```
  330 GSS=GTT                                                    AIM   60
  331 SL=-GTP                                                    AIM   61
  332 EL=1.0                                                     AIM   62
  333 L=2                                                        AIM   63
  334 GO TO 316                                                  AIM   64
C                                                                AIM   65
  335 L=3                                                        AIM   66
  336 GO TO 316                                                  AIM   67
    1 FORMAT (9HORICOCHET)                                       AIM   68
      END                                                        AIM   69
```

```
CARFDT2                                                                 ARFDT  1
      IMPLICIT REAL*8 (A-H,O-Z)                                         ARFDT  2
      SUBROUTINE ARFDT2(H,ASOUND,RHO)                                   ARFDT  3
C                                                                       ARFDT  4
C         SUBROUTINE ARFDT2 CALLS IN SUBROUTINE COMP62 AND CONVERTS THEARFDT  5
C       NON-DIMENSIONAL DENSITY OBTAINED FROM IT INTO UNITS OF SLUGS    ARFDT  6
C       PER CUBIC FOOT.                                                 ARFDT  7
C                                                                       ARFDT  8
      RHOO = 0.0023769D0                                                ARFDT  9
      CALL COMP62(H, RHO,ASOUND,T,P)                                    ARFDT 10
      RHO= RHO* RHOO                                                    ARFDT 11
      RETURN                                                            ARFDT 12
      END                                                               ARFDT 13
```

```
CAR2DIM
      IMPLICIT REAL * 8 (A-H, O-Z )
            SUBROUTINE  AR2DIM(N, M, X, XTB, Y, YTB, Z , ZTB  )
C   AR2DIM  NOTE THIS HAS ZTB(J,I) . THE LIBRARY HAS Z(I,J)
      DIMENSION  XTB(N) ,YTB(M) ,  ZTB(M, N)
C
C
C           SUBROUTINE AR2DIM PERFORMS A LINEAR INTERPOLATION IN A TWO-
C        DIMENSIONAL TABLE FOR Z AS A FUNCTION OF X AND Y.
C
C
        NN = N-1
        MM =M-1
         DO 5  I = 1, NN
         I = I
       IF( XTB(I&1) -X ) 5, 6, 6
    6  P2  = (X- XTB(I) ) / (XTB(I&1) - XTB(I) )
          GO TO 7
    5  CONTINUE
C
    7   DO 9 J =1, MM
        J=J
       IF( YTB(J&1) - Y )  9, 10, 10
   10  P1 = (Y- YTB(J)) / ( YTB(J&1) -YTB(J) )
             GO TO 11
    9  CONTINUE
C
   11    Z = (1.DO -P1 -P2 & P1 * P2) * ZTB(J,I) & ( P2 -P2 * P1) * ZTB(J
     1,I&1)  &( P1 - P1 * P2) * ZTB(J&1,I) &  P1 * P2 * ZTB(J&1,I&1)
C
   13  RETURN
       END
```

```
CAR3DIM
      IMPLICIT REAL * 8( A-H, O-Z )
      FUNCTION AR3DIM( D , N20, M20, N10 ,  ROW, H , EM  ,XYZTBL )
      DIMENSION D(N20, M20, N10 ) , XYZTBL( I1,3)
C
C
C          FUNCTION AR3DIM IS THE RESULT OF A TABLE LOOK-UP EMPLOYING
C        LINEAR INTERPOLATION TO DETERMINE THE VALUE OF A DEPENDENT
C        VARIABLE WHICH IS A FUNCTION OF THREE INDEPENDENT VARIABLES.
C
C
      DO 1  I=2, N10
         I=I
      IF( EM .LE. XYZTBL( I,3) ) GO TO 2
    1 CONTINUE
C
      I= N10
      WRITE(6,1000)  XYZTBL(I,3)
 1000   FORMAT(  '   THE VALUE OF M-RAT IS GREATER THAN THE M-RAT VALUE
     1OF THE LARGEST D-TABLE WHICH IS'1P1D18.6  /)
C
    2 CONTINUE
      I1= I-1
      CALL AR2DIM( N20, M20, ROW, XYZTBL(1,1),  H, XYZTBL(1,2),
     1 ANS1   , D(1,1,I1)  )
      CALL AR2DIM( N20, M20, ROW, XYZTBL(1,1),  H, XYZTBL(1,2),
     1 ANS2   , D(1,1,I)  )
      AR3DIM = (ANS1 *(XYZTBL( I,3) - EM)  & ANS2 * (EM - XYZTBL(I1,3
     1) )  ) / ( XYZTBL(I,3) -XYZTBL(I1,3)  )
C
      RETURN
      END
```

```
CAVPLT  PROGRAM 2542
CAVPLT WITH CORE REMOVED  SEPT. 11, 1968
CAVPLT
      SUBROUTINE AVPLT(XQ,IZ,X,Y,Z,KY,IC)
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON OCCUR, NOCCUR
      COMMON /CPCCUR/ PCCUR(11770)
      COMMON /CICCUR/ IOCCUR(320)
      REAL*4 B,B1,B2,B3,   XQ
       DIMENSION  XQ(40),  IOP(90)
      DIMENSION B1(18),B2(10),B3(10),IC(1),      HOLD(3,50),IZ(1)
      DIMENSION NOCCUR(30),NPV(160),OCCUR(4000),R(3),SAVE(9,160,3),
     1 W(160)
      DIMENSION X(1),Y(1),Z(1),ZPLOT(160)
       DIMENSION  T(200)
       EQUIVALENCE  (PCCUR(07101), HOLD  )
       EQUIVALENCE  (PCCUR(07251), SAVE  )
       EQUIVALENCE  (PCCUR(05561), T     )
       EQUIVALENCE  (PCCUR(00161), ZPLOT )
      EQUIVALENCE  (IOCCUR(00308), II     )
      EQUIVALENCE  (IOCCUR(00309), IMPLOT)
      EQUIVALENCE  (IOCCUR(00001), IOP    )
      EQUIVALENCE  (IOCCUR(00310), JJ     )
      EQUIVALENCE(IOCCUR(000313), KX     )
      EQUIVALENCE  (IOCCUR(00302), LPLOT)
      EQUIVALENCE  (IOCCUR(00312), NCON   )
      EQUIVALENCE  (IOCCUR(00305), NDECOY)
      EQUIVALENCE  (IOCCUR(00307), NPA    )
      EQUIVALENCE  (IOCCUR(00141), NPV    )
      DATA B/4H    /
C
C
C          SUBROUTINE AVPLT CAN PRODUCE FOUR KINDS OF PLOTS, DEPENDING
C        ON THE VALUE OF KY.  IF KY=1, INFLUENCE COEFFICIENT PLOTS WILL
C        BE PREPARED AT A SPECIFIED NUMBER OF ALTITUDES, NPA.  IF KY=2,
C        ONE CORRIDOR PLOT IS PRODUCED.  IF KY=3, ONE PLOT OF Y VS. X
C        IS PRODUCED.  IF KY=4, ONE PLOT OF LOG(Y) TO THE BASE 10 VS.
C        X WILL BE PRODUCED.  IF KY=5, THE PLOT FILE WILL BE CLOSED AND
C        THE COMPUTER RUN WILL BE TERMINATED.
C
C
      REWIND 9
      IF(IMPLOT.NE.0) GO TO 10
      CALL IDFRMV(12HLORAYNE K210,2H  ,8H2542F   )
      IMPLOT = 1
C
C
   10 GO TO (20,20,110,110,230), KY
   20 CONTINUE
      WRITE(9,2000) IC(1), IC(2)
      DO 33 I = 1, 19
      JP = I
      IF(IZ(I).EQ.NCON) GO TO 40
   33 CONTINUE
      JP = 0
      GO TO 45
   40 JS = JP + JP
      JR = JS -1
   45 IF(KY.EQ.2) GO TO 70
C
```

```
C
      W(1)= HØLD(1,II)
      W(2)= HØLD(2,II)
      W(3)= HØLD(3,II)
      DØ 66 I=1,NPA
      J = NPV(I)
      R(1) = SAVE(JJ,J,1)
      R(2) = SAVE(JJ,J,2)
      R(3) = SAVE(JJ,J,3)
      WRITE(9,2100)(ØCCUR(L),L=127,129),ZPLØT(J)
      IF(JP.EQ.0) GØ TØ 50
      WRITE(9,2200) XQ(JR), XQ(JS)
      GØ TØ 55
   50 WRITE(9,2300) NCØN
   55  ENDFILE 9
      REWIND 9
      READ(9, 3100) B2
      READ(9, 2900) B1
      READ(9, 3100) B3
      REWIND 9
      IF(IØP(76).EQ.1) GØ TØ 60
C
      XL = DMIN1(W(1),W(2),W(3))
      XU = DMAX1(W(1),W(2),W(3))
      YL = DMIN1(R(1),R(2),R(3))
      YU = DMAX1(R(1),R(2),R(3))
      XU = (XU -XL)/8.D0
      XL = XL -XU
      YU = (YU -YL)/8.D0
      YL = YL -YU
      CALL PLT(1,0,XL,XU,W,0,25,YL,YU,7,0,R,70,B1,40,B3,40,B2)
      CALL PLT(2,3,1)
      CALL PLT(5,12,PLTIM)
      WRITE(6,3000) PLTIM
      GØ TØ 66
C
   60 CALL EZPLØT(9.,1,1,W,R,3,1,1,55,70,B1,40,B3,40,B2,1,1,XL,XU,1,
     1YL,YU,1,0,1)
C
   66 CØNTINUE
      RETURN
C
C
C
C
   70 XU = ZPLØT(1)
       XL = ZPLØT(LPLØT)
      CALL MAXMIN(KX,KX,X ,XMIN,XMAX)
      CALL MAXMIN(KX,KX,Y ,YMIN,YMAX)
      CALL MAXMIN(KX,KX,Z ,ZMIN,ZMAX)
      YL = DMIN1(XMIN,YMIN,ZMIN)
      YU = DMAX1(XMAX,YMAX,ZMAX)
      WRITE(9,2500)
      IF(NDECØY.GT.1) GØ TØ 80
      WRITE(9,2400)(ØCCUR(L),L=127,129)
      GØ TØ 95
   80 IF(JP.EQ.0) GØ TØ 90
      JT = IZ(JP)
      WRITE(9,2600)(ØCCUR(L),L=127,129),XQ(JR),XQ(JS),ØCCUR(JT)
```

```
      GO TØ 95                                                          AVPLT120
   90 WRITE(9,2700)(ØCCUR(L),L=127,129),NCØN,ØCCUR(NCØN)                AVPLT121
   95  ENDFILE 9                                                        AVPLT122
      REWIND 9                                                          AVPLT123
      READ(9, 3100) B2                                                  AVPLT124
      READ(9, 3100) B3                                                  AVPLT125
      READ(9, 2900) B1                                                  AVPLT126
      REWIND 9                                                          AVPLT127
      IF(IØP(76).EQ.1) GØ TØ 100                                        AVPLT128
C                                                                       AVPLT129
        XU = (XU-XL)/8.0D0                                              AVPLT130
      XL = XL -XU                                                       AVPLT131
      YU = (YU -YL)/8.D0                                                AVPLT132
      YL = YL -YU                                                       AVPLT133
      NF = 123                                                          AVPLT134
      CALL PLT(1,0,XL,XU,T,0,NF,YL,YU,4,1,X,YL,YU,4,1,Y,YL,YU,4,1,Z,    AVPLT135
     1 70,B1,8,B3,8,B2,8,B3,8,B2,8,B3,8,B2)                             AVPLT136
      CALL PLT(2,KX,1)                                                  AVPLT137
      CALL PLT(5,12,PLTIM)                                              AVPLT138
      WRITE(6,3000) PLTIM                                               AVPLT139
      RETURN                                                            AVPLT140
  100 CALL EZPLØT(9.,1,1,T,X,KX,1,2,42,70,B1,40,B3,40,B2,1,-2,XL,XU,-2, AVPLT141
     1YL,YU,1,0,1)                                                      AVPLT142
      CALL EZPLØT(9.,1,1,T,Z,KX ,1,2,42,1,B,1,B,1,B,2,-2,XL,XU,-2,YL,YU,AVPLT143
     1 1,0,1)                                                           AVPLT144
      CALL EZPLØT(9.,1,1,T     ,Y,KX    ,1,2,42,1,B,1,B,1,B,2,-2,XL,    AVPLT145
     1 XU,-2,YL,YU,1,0,1)                                               AVPLT146
      RETURN                                                            AVPLT147
C                                                                       AVPLT148
C                                                                       AVPLT149
C                                                                       AVPLT150
  110 N = 1                                                             AVPLT151
      IF(IC(1).EQ.0.AND.KY.EQ.4) N = 2                                  AVPLT152
      DØ 111 J = 2, LPLØT                                               AVPLT153
      IF(Y(J-1).NE.Y(J))GØ TØ 120                                       AVPLT154
  111 CØNTINUE                                                          AVPLT155
      RETURN                                                            AVPLT156
  120 DØ 121 I = 1, LPLØT                                               AVPLT157
      W(I) = Y(I)                                                       AVPLT158
  121 CØNTINUE                                                          AVPLT159
      IF(N.NE.2) GØ TØ 125                                              AVPLT160
      IF(KY.NE.4) GØ TØ 125                                             AVPLT161
      IF(IC(1).NE.0) GØ TØ 125                                          AVPLT162
      DØ 122 I = 1, LPLØT                                               AVPLT163
      W(I) = DLØG10(W(I))                                               AVPLT164
  122 CØNTINUE                                                          AVPLT165
  125 CØNTINUE                                                          AVPLT166
      WRITE(9,2800)(ØCCUR(L),L=127,129)                                 AVPLT167
       ENDFILE 9                                                        AVPLT168
      REWIND 9                                                          AVPLT169
      READ(9, 2900) B1                                                  AVPLT170
      REWIND 9                                                          AVPLT171
      IF(IØP(76).EQ.1) GØ TØ 130                                        AVPLT172
C                                                                       AVPLT173
      XU = (ZPLØT(1)-ZPLØT(LPLØT))/8.D0                                 AVPLT174
      XL = ZPLØT(LPLØT) -XU                                             AVPLT175
      CALL MAXMIN(LPLØT,LPLØT,W,YMIN,YMAX)                              AVPLT176
      YU = (YMAX-YMIN)/8.D0                                             AVPLT177
      YL = YMIN -YU                                                     AVPLT178
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      CALL PLT(1,0,XL,XU,X,0,25,YL,YU,4,0,W,70,B1,40,B3,40,B2)          AVPLT179
      CALL PLT(2,LPLØT,1)                                               AVPLT180
      CALL PLT(5,12,PLTIM)                                              AVPLT181
      WRITE(6,3000) PLTIM                                               AVPLT182
      RETURN                                                            AVPLT183
  130 CALL EZPLØT(9.,1,N,X,W,LPLØT,1,2,38,70,B1,40,XQ,40,IZ,1,1,XL,XU,1,AVPLT184
     1YL,YU,1,0,1)                                                      AVPLT185
       RETURN                                                           AVPLT186
C                                                                       AVPLT187
C                                                                       AVPLT188
C                                                                       AVPLT189
  230  IF(IØP(76).EQ.1) GØ TØ 240                                       AVPLT190
       CALL PLT(6)                                                      AVPLT191
       CALL EXIT                                                        AVPLT192
       RETURN                                                           AVPLT193
C                                                                       AVPLT194
C                                                                       AVPLT195
C                                                                       AVPLT196
  240  CALL FRAMEV                                                      AVPLT197
        CALL ENDJØB                                                     AVPLT198
        CALL PLTND                                                      AVPLT199
        RETURN                                                          AVPLT200
C                                                                       AVPLT201
C                                                                       AVPLT202
C                                                                       AVPLT203
C                                                                       AVPLT204
 2000  FØRMAT(1H 5HDELTA 2A4, 27X)                                      AVPLT205
 2100  FØRMAT(1H 5HDATE F9.3, 6H CASE F9.3,6H MEMØ F9.3, 10H ALTITUDE   AVPLT206
     1 F9.1, 9X)                                                        AVPLT207
 2200  FØRMAT(1H 2A4, 32X)                                              AVPLT208
 2300  FØRMAT(1H I12, 28X)                                              AVPLT209
 2400  FØRMAT(1H 5HDATE F9.3, 6H CASE F9.3, 6H MEMØ F9.3, 28X)          AVPLT210
 2500  FØRMAT(1H 8HALTITUDE 32X)                                        AVPLT211
 2600  FØRMAT(1H 5HDATE F9.3, 6H CASE F9.3, 6H MEMØ F9.3, 1X 2A4, 1X    AVPLT212
     1 F10.2, 8X)                                                       AVPLT213
 2700  FØRMAT(1H 5HDATE F9.3,6H CASE F9.3, 6H MEMØ F9.3, 1X I8, 1X      AVPLT214
     1 F10.2, 8X)                                                       AVPLT215
 2800  FØRMAT(1H 30HRESULTS ØF PRØGRAM 2542F DATE F9.3, 6H CASE F9.3,   AVPLT216
     1 6H MEMØ F9.3, 3X)                                                AVPLT217
 2900  FØRMAT(1H 18A4)                                                  AVPLT218
 3000  FØRMAT(1H0 8HPLØTIM = F10.4)                                     AVPLT219
 3100  FØRMAT(1H 10A4)                                                  AVPLT220
       END                                                              AVPLT221
```

```
CBESSEL
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE BESSEL(XR,XI,C,N,ZNRO,ZNIO,
     1IT)
      DIMENSION ZNRO(25,25),ZNIO(25,25)
C
C
C        SUBROUTINE BESSEL CALCULATES FOR COMPLEX ARGUMENTS THE BESSEL
C     FUNCTIONS OF INTEGRAL ORDER ZERO THROUGH TWENTY-FOUR.  JNXBES
C     IS CALLED TO CALCULATE THE BESSEL FUNCTION OF MAXIMUM ORDER, N,
C     AND OF N-1.   THEN A RECURSIVE FORMULA IS USED TO CALCULATE
C     EACH DIMINISHING ORDER UNTIL THE ZEROTH ORDER IS DETERMINED.
C
      N1=N&1
      B=XR**2&XI**2
      IF (B)2,4,2
C
    4 ZNRO(N1,IT)=0.0D0
      ZNIO(N1,IT)=0.0D0
      ZNRO(N,IT)=0.0D0
      ZNIO(N,IT)=0.0D0
      GO TO 5
C
    2 CONTINUE
      CALL JNXBES(XR,XI,N,C,ZNRO(N1,IT),ZNIO(N1,IT))
      NN=N-1
      CALL JNXBES(XR,XI,NN,C,ZNRO(N,IT),ZNIO(N,IT))
      XRB=XR/B
      XIB=-XI/B
C
    5 DO 1 I=2,N
      NN=N-I
      XNN=FLOAT(NN&1)
      NN1=NN&1
      NN2=NN&2
      NN3=NN&3
      ZNRO(NN1,IT)=2.D0*XNN*(ZNRO(NN2,IT)*XRB-ZNIO(NN2,IT)*XIB)-ZNRO(NN3
     X,
     1IT)
    1 ZNIO(NN1,IT)=2.D0*XNN*(ZNRO(NN2,IT)*XIB&ZNIO(NN2,IT)*XRB)-ZNIO(NN3
     X,
     1IT)
      RETURN
      END
```

```
CCHNTB
       IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE CHNTBL(DVALUE,ZTURNX,LCHNGE)
C
      REAL*8 LAMDA,LA,NSL,NGL,NST,NGT,LAMDA1,LAMDA2,LA1,LA2,LA1F,LAMD1F
C
      DIMENSION
     1              TXCGD(50),TABI(50),TABIX(50),TABZ(50),TW(4,8),
     2              OCCUR(4000),NOCCUR(30),DVALUE(16),TABIX1(50),TABIX2(50)
     3             ,TXCGD1(50),TXCGD2(50),TABI1(50),TABI2(50),TABZ1(50),
     4              TABZ2(50)
C
      EQUIVALENCE
     1(OCCUR(004),BETA1 ),(OCCUR(005),BETA2 ),(OCCUR(006),BETA3 ),
     2(OCCUR(007),BETA4 ),(OCCUR(008),COST  ),(OCCUR(014),CP2    ),
     3(OCCUR(015),CPG    ),(OCCUR(022),DELRHO),(OCCUR(023),DELHC ),
     4(OCCUR(024),EPSIL ),(OCCUR(025),F      )
      EQUIVALENCE
     1(OCCUR(030),HREF  ),(OCCUR(032),LAMDA ),(OCCUR(033),LA      ),
     2(OCCUR(038),NSL   ),(OCCUR(039),NGL   ),(OCCUR(040),NST     ),
     3(OCCUR(041),NGT   ),(OCCUR(042),PI    ),(OCCUR(052),RN      ),
     4(OCCUR(053),RB    ),(OCCUR(054),RESINT),(OCCUR(058),RHC2    ),
     5(OCCUR(064),SINT  ),(OCCUR(066),SQCOST),(OCCUR(069),THETAC),
     6(OCCUR(070),TANT  ),(OCCUR(073),TWSTAG),(OCCUR(074),TWO     ),
     7(OCCUR(076),THETA ),(OCCUR(084),W     ),(OCCUR(085),WO      ),
     8(OCCUR(124),CMOIN1),(OCCUR(125),CMOIN2)
      EQUIVALENCE
     1(OCCUR(133),W1    ),(OCCUR(134),THETA1),(OCCUR(135),RN1     ),
     2(OCCUR(136),RB1   ),(OCCUR(137),LAMDA1),(OCCUR(138),LA1     ),
     3(OCCUR(139),W2    ),(OCCUR(140),THETA2),(OCCUR(141),RN2     ),
     4(OCCUR(142),RB2   ),(OCCUR(143),LAMDA2),(OCCUR(144),LA2     ),
     5(OCCUR(145),ZTURN ),(OCCUR(146),LA1F  ),(OCCUR(147),RB1F    ),
     6(OCCUR(149),TW1   ),(OCCUR(150),THET1F),(OCCUR(151),LAMD1F),
     7(OCCUR(168),TW2   ),(OCCUR(169),RN1F  ),(OCCUR(170),W1F     )
      EQUIVALENCE
     1(OCCUR(190),FACTR2),(OCCUR(191),FACTR3),
     2(OCCUR(192),FACTR4),(OCCUR(193),FACTR5),(OCCUR(194),FACTR6),
     3(OCCUR(195),FACTR7),(OCCUR(196),CMOIN ),(OCCUR(204),WTH     ),
     4(OCCUR(228),WTOTAL)
      EQUIVALENCE
     1(OCCUR(0844), TXCGD(1)),(OCCUR(0894),  TABI(1)),
     2(OCCUR(0944), TABIX(1)),(OCCUR(0994),  TABZ(1)),
     3(OCCUR(2644),    TW(1,1)),
     4(OCCUR(2833),TXCGD1(1)),(OCCUR(2883),TXCGD2(1)),
     5(OCCUR(2933), TABI1(1)),(OCCUR(2983), TABI2(1)),
     6(OCCUR(3033),TABIX1(1)),(OCCUR(3083),TABIX2(1)),
     7(OCCUR(3133), TABZ1(1)),(OCCUR(3183), TABZ2(1))
      EQUIVALENCE
     1(NOCCUR(01),JJHOLD),(NOCCUR(04),MAXTAB),(NOCCUR(05),NOSEUP),
     2(NOCCUR(10), MHEAT),(NOCCUR(13),MATLNO),(NOCCUR(15),NGECM ),
     3(NOCCUR(16),MXTAB1),(NOCCUR(17),MXTAB2),(NOCCUR(20),MATLN1),
     4(NOCCUR(21),MATLN2)
C
      COMMON OCCUR,NOCCUR
C
C
C
C          SUBROUTINE CHNTBL ASSIGNS THE APPROPRIATE GEOMETRIC AND
C        MATERIAL PROPERTIES AS INITIAL VALUES AT THE REENTRY ALTITUDE
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```
C         AND AT ALTITUDE ZTURN, WHERE THE INTEGRATION IS RESTARTED       CHNTB 60
C         AFTER DISCONTINUOUS CHANGE IN CONFIGURATION.  THE TABLES WITH   CHNTB 61
C         SUBSCRIPT 1 ARE FOR THE INITIAL CONDITIONS AT REENTRY, THOSE    CHNTB 62
C         SUBSCRIPTED WITH A 2 ARE CONFIGURATION PARAMETERS AT ZTURN.     CHNTB 63
C                                                                         CHNTB 64
C                                                                         CHNTB 65
      JJHOLD=0                                                            CHNTB 66
      GO TO(100,200),LCHNGE                                               CHNTB 67
  100 ZTURNX=ZTURN                                                        CHNTB 68
C                                                                         CHNTB 69
C            GEOMETRY DESCRIPTION AT REENTRY ALTITUDE Z0                  CHNTB 70
      DO 101 J=1,50                                                       CHNTB 71
      TXCGD(J)=TXCGD1(J)                                                  CHNTB 72
      TABI(J)=TABI1(J)                                                    CHNTB 73
      TABIX(J)=TABIX1(J)                                                  CHNTB 74
  101 TABZ(J)=TABZ1(J)                                                    CHNTB 75
      CMQIN=CMQIN1                                                        CHNTB 76
      MAXTAB=MXTAB1                                                       CHNTB 77
      TWO=TW1                                                             CHNTB 78
      JJ=151                                                              CHNTB 79
      MATLNO=MATLN1                                                       CHNTB 80
C                                                                         CHNTB 81
      GO TO (102,103,104),NGEOM                                           CHNTB 82
C                                                                         CHNTB 83
C            NGEOM=1   INPUT WEIGHT,CONE HALF ANGLE,NOSE AND BASE RADII   CHNTB 84
  102 W=W1                                                                CHNTB 85
      THETA=THETA1                                                        CHNTB 86
      RN=RN1                                                              CHNTB 87
      RB=RB1                                                              CHNTB 88
      LAMDA1=RN1/RB1                                                      CHNTB 89
      SINTH1=DSIN(THETA1*0.01745329D0)                                    CHNTB 90
      COSTH1=DCOS(THETA1*0.01745329D0)                                    CHNTB 91
      LA1=RB1*(COSTH1-LAMDA1*(1.0D0-SINTH1))/SINTH1                       CHNTB 92
      GO TO 300                                                           CHNTB 93
C                                                                         CHNTB 94
C            NGEOM=2   INPUT WEIGHT,BASE RADIUS,CONE HALF ANGLE, AND      CHNTB 95
C         BLUNTNESS RATIO                                                 CHNTB 96
  103 W=W1                                                                CHNTB 97
      THETA=THETA1                                                        CHNTB 98
      RB=RB1                                                              CHNTB 99
      RN=RB1*LAMDA1                                                       CHNTB100
      SINTH1=DSIN(THETA1*0.01745329D0)                                    CHNTB101
      COSTH1=DCOS(THETA1*0.01745329D0)                                    CHNTB102
      LA1=RB1*(COSTH1-LAMDA1*(1.0D0-SINTH1))/SINTH1                       CHNTB103
      GO TO 300                                                           CHNTB104
C                                                                         CHNTB105
C            NGEOM=3   INPUT WEIGHT,NOSE RADIUS,BASE RADIUS,AXIAL LENGTH  CHNTB106
  104 W=W1                                                                CHNTB107
      RN=RN1                                                              CHNTB108
      RB=RB1                                                              CHNTB109
      TEM=LA1-RN1                                                         CHNTB110
      TEST=TEM*TEM-RN1*RN1&RB1*RB1                                        CHNTB111
      IF(TEST.LT.0.0D0)GO TO 35                                           CHNTB112
      THETA=180.0D0*ASINP((-(LA1-RN1)*RN1&RB1*SQRT(TEST))/                CHNTB113
     1(TEST&RN1*RN1))/PI                                                  CHNTB114
      GO TO 300                                                           CHNTB115
C                                                                         CHNTB116
  200 ZTURNX=-1.0D10                                                      CHNTB117
      LA1F=LA*12.0D0                                                      CHNTB118
      RB1F=RB*12.0D0                                                      CHNTB119
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      THETIF=THETA*57.29578DC                                           CHNTB120
      RNIF=RN*12.0DC                                                    CHNTB121
      LAMDIF=LAMDA                                                      CHNTB122
      WIF=WTOTAL                                                        CHNTB123
C                                                                       CHNTB124
C          GEOMETRY DESCRIPTION AT ALTITUDE ZTURN                       CHNTB125
      DO 201 J=1,50                                                     CHNTB126
      TXCGD(J)=TXCGD2(J)                                                CHNTB127
      TABI(J)=TABI2(J)                                                  CHNTB128
      TABIX(J)=TABIX2(J)                                                CHNTB129
  201 TABZ(J)=TABZ2(J)                                                  CHNTB130
      CMQIN=CMQIN2                                                      CHNTB131
      MAXTAB=MXTAB2                                                     CHNTB132
      TWO=TW2                                                           CHNTB133
      JJ=170                                                            CHNTB134
      MATLNO=MATLN2                                                     CHNTB135
C                                                                       CHNTB136
      GO TO(202,203,204),NGEOM                                          CHNTB137
C                                                                       CHNTB138
C          NGEOM=1   INPUT WEIGHT,CONE HALF ANGLE,NOSE AND BASE RADII   CHNTB139
  202 W=W2                                                              CHNTB140
      THETA=THETA2                                                      CHNTB141
      RN=RN2                                                            CHNTB142
      RB=RB2                                                            CHNTB143
      LAMDA2=RN2/RB2                                                    CHNTB144
      SINTH2=DSIN(THETA2*0.01745329D0)                                  CHNTB145
      COSTH2=DCOS(THETA2*0.01745329D0)                                  CHNTB146
      LA2=RB2*(COSTH2-LAMDA2*(1.0D0-SINTH2))/SINTH2                     CHNTB147
      GO TO 300                                                         CHNTB148
C                                                                       CHNTB149
C          NGEOM=2   INPUT WEIGHT,BASE RADIUS,CONE HALF ANGLE, AND      CHNTB150
C        BLUNTNESS RATIO                                                CHNTB151
  203 W=W2                                                              CHNTB152
      THETA=THETA2                                                      CHNTB153
      RB=RB2                                                            CHNTB154
      RN=RB2*LAMDA2                                                     CHNTB155
      SINTH2=DSIN(THETA2*0.01745329D0)                                  CHNTB156
      COSTH2=DCOS(THETA2*0.01745329D0)                                  CHNTB157
      LA2=RB2*(COSTH2-LAMDA2*(1.0D0-SINTH2))/SINTH2                     CHNTB158
      GO TO 300                                                         CHNTB159
C                                                                       CHNTB160
C          NGEOM=3   INPUT WEIGHT,NOSE RADIUS,BASE RADIUS,AXIAL LENGTH  CHNTB161
  204 W=W2                                                              CHNTB162
      RN=RN2                                                            CHNTB163
      RB=RB2                                                            CHNTB164
      TEM=LA2-RN2                                                       CHNTB165
      TEST=TEM*TEM-RN2*RN2&RB2*RB2                                      CHNTB166
      IF(TEST.LT.0.0D0)GO TO 35                                         CHNTB167
      THETA=180.0D0*ASINR((-(LA2-RN2)*RN2&RB2*SQRT(TEST))/              CHNTB168
     1(TEST&RN2*RN2))/PI                                                CHNTB169
  300 CONTINUE                                                          CHNTB170
C                                                                       CHNTB171
C          MATLNO=1 IS TEFLON                                           CHNTB172
C          MATLNO=2 IS LTALPHA                                          CHNTB173
C          MATLNO=3 IS OTWR                                             CHNTB174
C          MATLNO=4 IS PHENOLIC NYLON                                   CHNTB175
C          MATLNO=5 IS CARBON PHENOLIC                                  CHNTB176
C          MATLNO=6 IS AN INPUT MATERIAL                                CHNTB177
C                                                                       CHNTB178
      IF(MATLNO.GT.6)WRITE(6,1031)MATLNO                                CHNTB179
```

```
      IF(MATLNO.GT.6)MATLNO=1
   55 GO TO (31,37,32,36,35,33),MATLNO
C
C               TEFLON PROPERTIES
   31    BETA1=0.D0
         BETA2=2.162D4
         BETA3=0.59D0
         BETA4=3.645D4
          HREF=0.D0
             F=485.D0
          RHO2=136.D0
        DELRHO=0.D0
           CP2=0.26D0
           CPC=0.D0
      NSL=0.528D0
      NST=0.282D0
           NGL=0.D0
           NGT=0.D0
         DELHC=0.D0
         EPSIL=0.4D0
      GO TO 34
C
C               LTALPHA PROPERTIES
   37 BETA1=0.D0
      BETA2=0.5417D0
      BETA3=0.5D0
      BETA4=1.6D4
      HREF=0.0D0
      F=207.0D0
      RHO2=66.4D0
      DELRHO=0.0D0
      CP2=0.52D0
      CPC=0.0D0
      NSL=0.57D0
      NST=0.458D0
      NGL=0.0D0
      NGT=0.0D0
      DELHC=0.0D0
      EPSIL=0.75D0
      GO TO 34
C
C               OTWR PROPERTIES
   32    BETA1=0.D0
         BETA2=.185D10
         BETA3=-0.50D0
         BETA4=1.16D5
          HREF=0.D0
             F=2565.D0
          RHO2=82.D0
        DELRHO=20.D0
           CP2=0.22D0
           CPC=0.423D0
           NSL=0.607D0
           NST=0.303D0
           NGL=0.847D0
           NGT=0.372D0
         DELHC=950.D0
         EPSIL=0.5D0
      GO TO 34
C
```

```
C          PHENOLIC NYLON PROPERTIES
   38 BETA1=0.0D0
      BETA2=0.0D0
      BETA3=0.0D0
      BETA4=0.0D0
      HREF=0.0D0
      F=400.0D0
      RHO2=30.0D0
      DELRHO=45.0D0
      CP2=0.38D0
      CPG=0.0D0
      NSL=0.52D0
      NST=0.20D0
      NGL=0.52D0
      NGT=0.20D0
      DELHC=0.0D0
      EPSIL=0.80D0
      GO TO 34
C
C          CARBON PHENOLIC PROPERTIES
   39 BETA1=0.0D0
      BETA2=5.1D5
      BETA3=0.29D0
      BETA4=1.61D5
      HREF=0.0D0
      F=11050.0D0
      RHO2=85.7D0
      DELRHO=0.0D0
      CP2=0.348D0
      CPG=0.0D0
      NSL=0.0D0
      NST=0.0D0
      NGL=0.0D0
      NGT=0.0D0
      DELHC=0.0D0
      EPSIL=0.8D0
      GO TO 34
C
C          INPUT MATERIAL PROPERTIES
   33 BETA1=OCCUR(JJ&1 )
      BETA2=OCCUR(JJ&2 )
      BETA3=OCCUR(JJ&3)
      BETA4=OCCUR(JJ&4)
      HREF=OCCUR(JJ&5)
      F=OCCUR(JJ&6)
      RHO2=OCCUR(JJ&7)
      DELRHO=OCCUR(JJ&8)
      CP2=OCCUR(JJ&9)
      CPG=OCCUR(JJ&10)
      NSL=OCCUR(JJ&11)
      NST=OCCUR(JJ&12)
      NGL=OCCUR(JJ&13)
      NGT=OCCUR(JJ&14)
      DELHC=OCCUR(JJ&15)
      EPSIL=OCCUR(JJ&16)
   34 CONTINUE
C
C          TESTING CONE HALF ANGLE WITH RANGE OF APPLICABILITY
      IF(THETA.LT.4.0D0)GO TO 57
      IF(THETA.LT.40.0D0)GO TO 5
```

```
   57 WRITE(6,1058)THETA                                               CHNTB300
 1058 FORMAT(1H0 10X,19HINPUT ERROR. THETA=F8.3,40H IS OUTSIDE THE RANGECHNTB301
     1 OF 4 TO 40 DEGREES)                                              CHNTB302
      JJHOLD=-1                                                         CHNTB303
      RETURN                                                            CHNTB304
    5 CONTINUE                                                          CHNTB305
C                                                                       CHNTB306
C           DEFINING TRIGONOMETRIC QUANTITIES                           CHNTB307
      THETAD=THETA                                                      CHNTB308
      THETA=0.01745329D0*THETA                                          CHNTB309
      SINT=SIN(THETA)                                                   CHNTB310
      COST=COS(THETA)                                                   CHNTB311
      TANT=SINT/COST                                                    CHNTB312
      RESINT=1.D0/SINT                                                  CHNTB313
      SQCOST=COST*COST                                                  CHNTB314
C                                                                       CHNTB315
C           DEFINING INITIAL VALUES OF DVALUE ASSOCIATED WITH GEOMETRY  CHNTB316
      CVALUE(5)=W                                                       CHNTB317
      CVALUE(6)=RN                                                      CHNTB318
      CVALUE(7)=RB                                                      CHNTB319
      WO=W                                                              CHNTB320
      WTH=W                                                             CHNTB321
      CVALUE(16)=WTH                                                    CHNTB322
C                                                                       CHNTB323
C           DEFINING INITIAL VALUES FOR WALL TEMPERATURE                CHNTB324
      TWSTAG=TWO                                                        CHNTB325
      TW(1,1)=TWO                                                       CHNTB326
      TW(4,1)=TWO                                                       CHNTB327
      DO 36 J=1,8                                                       CHNTB328
      TW(2,J)=TWO                                                       CHNTB329
   36 TW(3,J)=TWO                                                       CHNTB330
C                                                                       CHNTB331
C           FOLLOWING FACTORS ARE USED IN EVIL                          CHNTB332
      FACTR2=DLOG(1.11C5D7)                                             CHNTB333
      FACTR3=12.7657D0&2.5984D0                                         CHNTB334
      FACTR4=RHO2*CP2&CPG*DELRHO                                        CHNTB335
      FACTR5=DELRHO*DELHC                                               CHNTB336
      FACTR6=RHO2*NSL&DELRHO*NGL                                        CHNTB337
      FACTR7=RHO2*NST&DELRHO*NGT                                        CHNTB338
C                                                                       CHNTB339
C           TESTS ON VALUES INPUT FOR OPTIONS                           CHNTB340
      IF(MATLNO.LT.1)WRITE(6,1031)MATLNO                                CHNTB341
      IF(NOSEOP.GT.1)WRITE(6,1103)NOSEOP                                CHNTB342
 1103 FORMAT(1H0 10X,24H*****WARNING*****NOSEOP=I3,43H IS NOT ALLOWED, NCHNTB343
     1OSEOP IS TAKEN TO BE = 0.)                                        CHNTB344
      IF(MHEAT.GT.1)WRITE(6,1104)MHEAT                                  CHNTB345
 1104 FORMAT(1H0 10X,23H*****WARNING*****MHEAT=I3,25H IS THE SAME AS MHECHNTB346
     1AT = 1.)                                                          CHNTB347
 1031 FORMAT(1H0 10X,25H*****WARNING***** MATLNO=I3,24H IS THE SAME AS MCHNTB348
     1ATLNO=1)                                                          CHNTB349
      RETURN                                                            CHNTB350
   35 JJHOLD=-1                                                         CHNTB351
      WRITE(6,1035)LCHNGE                                               CHNTB352
 1035 FORMAT(1H0 10X,6HTABLE ,I2,28H GIVES NEGATIVE SQUARE ROOT.)       CHNTB353
      RETURN                                                            CHNTB354
      END                                                               CHNTB355
```

```
CCLASSC
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE CLASSC(F321)
      COMMON OCCUR,NOCCUR
      COMMON/END/ITERM
      DIMENSION OCCUR(4000),NOCCUR(30), X(4000), A(514)
      EQUIVALENCE(OCCUR(1),X(1)),(OCCUR(301),A(1)),(NOCCUR(3),IOP)
      EQUIVALENCE (OCCUR(4000),LP)
C
C
C          SUBROUTINE CLASSC CONTAINS CLASSIC FUNCTIONS WHICH ARE
C       DESIGNED TO PROVIDE DIFFICULT TESTS OF HOW WELL A MINIMIZATION
C       ROUTINE WORKS.
C
C
      IF(IOP.EQ. 3) GO TO 300
      IF(IOP.EQ.4) GO TO 401
      IF(IOP.EQ.5) GO TO 501
      F= 100.0D0*(X(2)-X(1)**2)**2 & (1.0D0 - X(1))**2 &A(1)
      X(100) =F
      IF( IABS(IOP).EQ. 1) GO TO 999
C
  211 B= A(11) & (X(1)-A(7) )*(A(10) &(X(1)-A(7))*(A(9)&(X(1)-A(7))*
     1A(8)))
      C= A(16) & (X(1)-A(12))*(A(15) &(X(1)-A(12))*(A(14)&(X(1)-A(12))*
     1A(13)))
      X(101)= A(2)*(X(2)- B)
      X(102)= A(3)*(X(2)- C)
      GO TO 999
C
  300 FA =0.0D0
      FB =0.0D0
      FC =0.0D0
      FD =0.0D0
      FA = X(1)**2 &X(2)**2&2.D0*X(3)**2&X(4)**2 -5.0D0*X(1)-5.0D0*X(2)-
     121.0D0*X(3)& 7.0D0*X(4)& A(17)
      X(200) =FA
  301 FA2= 8.0D0& X(4)-X(3)&X(2)-X(1)-X(4)**2-X(3)**2-X(2)**2-X(1)**2
      X(201) =FA2
  302 FA3=10.0D0& X(4)&X(1) -2.0D0*X(4)**2 -X(3)**2- 2.0D0*X(2)**2
     1-X(1)**2
      X(202) =FA3
  303 FA4= 5.0D0&X(4)&X(2)-2.0D0*X(1) -2.0D0*X(1)**2-X(2)**2-X(3)**2
      X(203) =FA4
      GO TO 999
C
  401 F= 4.0D0*X(1)& X(2) &A(25)*(1.0D0/X(1) & 1.0D0/X(2) ) & A(26)
      X(300) =F
      GO TO 999
C
  501 F=A(1)*X(1)**2 &A(2)*X(1)*X(2) & A(3)*X(2)**2
     1&A(4)*X(1) & A(5)*X(2) &A(6)
      X(400)= F
      GO TO 999
C
  999 F321=0.0
      LP = 1
      RETURN
      END
```

```
CCOMP62
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE COMP62(H,RHO,ASOUND,T,P)
      DIMENSION  TB(26),HB(26),BM(26),R(26),PB(26),TATM(26)
C
C         SUBROUTINE COMP62 COMPUTES THE NON-DIMENSIONAL DENSITY AND
C        PRESSURE, TEMPERATURE IN DEGREES RANKINE, AND SPEED OF SOUND
C        IN FEET PER SECOND OF THE 1962 STANDARD ATMOSPHERE.  FROM
C        Z=0.0 FEET TO Z=300000. FEET THE SUBROUTINE IS EXACT.  FROM
C        Z=300000. FEET TO 2,275,000. FEET. COMPARES TO LESS THAN 1/2
C        OF 1 PER CENT.  ABOVE Z=2,275,000. FEET CONSTANT VALUES ARE
C        USED.
C
      DATA TB/
     1 320.6500,  288.1500,  216.6500,  216.6500,  228.6500,  270.6500,
     X 270.6500,
     2 252.6500,  180.6500,  180.6500,  210.6500,  235.6500,  260.6500,
     X 360.6500,
     3 560.6500,  960.6500,  1110.6500,  1210.6500,  1350.6500,  1550.65
     XD0,
     4 1830.6500,  2160.6500,  2290.6500,  2420.6500,  2590.6500,  2700.
     X6500/
C
      DATA HB/
     1 -5000.000,  0.000,  11000.000,  20000.000,  32000.000,  47000.000
     X,  52000.000,
     2 61000.000,  79000.000,  88743.000,  98451.000,  103294.000,  1081
     X29.000,
     3 117776.000,  127394.000,  146541.000,  156071.000,  165571.000,
     X184485.000,
     4 221967.000,  286476.000,  376312.000,  420240.000,  463526.000,
     X548230.000,
     5 630530.000/
C
      DATA BM/
     1 -0.006500, -0.006500, 0.000, 0.00100, 0.002800, 0.000,  -0.0
     X02000,
     2 -0.004000, 0.000, 0.003390200, 0.00516209000, 0.00517063100,
     3 0.0103659100,  0.0207943400,  0.02089100,  0.01573900,  0.0105263
     XD0,
     4 0.0074019300,  0.0053359000,  0.0043404800,  0.0036733600,  0.002
     X95938800,
     5 0.0030032800,  0.0020069900,  0.0013365700,  0.000/
C
      DATA R/
     1 0.193049997D01, 0.122500263D01, 0.363918856D-0, 0.880350657D-1,
     2 0.132250458D-1, 0.142753743D-2, 0.759434283D-3, 0.251091339D-3,
     3 0.200114310D-4, 0.317015171D-5, 0.497409776D-6, 0.211574012D-6,
     4 0.982986927D-7, 0.243629359D-7, 0.759159245D-8, 0.183655895D-8,
     5 0.115938455D-8, 0.804025792D-9, 0.434910767D-9, 0.156481698D-9,
     6 .358881794D-10, .650950819D-11, .312789872D-11, .157970712D-11,
     7                  0.464882739D-12, 0.154055260D-12/
C
      DATA PB/
     1 0.120676249D04, 0.472681269D03, 0.105578616D03, 0.255403660D02,
     2 0.404931098D01, 0.517378375D00, 0.275239632D-0, 0.849500768D-1,
     3 0.484093063D-2, 0.766885906D-3, 0.140309744D-3, 0.667954773D-4,
     4 0.343097486D-4, 0.117659643D-4, 0.569949880D-5, 0.236255541D-5,
     5 0.172430381D-5, 0.130345970D-5, 0.786596574D-6, 0.324727509D-6,
```

```
     6 0.879763417D-7,-0.188339643D-7, 0.959446043D-8, 0.512056269D-8,
     7 0.161272861D-8, 0.557126634D-9/
C
      DATA TWTM/
     1 28.9644D0,  28.9644D0,  28.9644D0,  28.9644D0,  28.9644D0,  28.96
     X44D0,
     2 28.9644D0,  28.9644D0,  28.9644D0,  28.9644D0,  28.88D0,  28.75D0
     X,  28.56D0,
     3 28.07D0,  27.58D0,  26.92D0,  26.66D0,  26.40D0,  25.85D0,  24.70
     XD0,  22.66D0,
     4 19.94D0,  18.82D0,  17.94D0,  16.84D0,  16.17D0/
C
      DATA AG /9.80665D0/, AMO /28.9644D0/, ARR /8.31432D&3/,
     2                   AR /6356766.0D0/, CON1 /0.3048D0/, CON2 /1.8D0
     X/,
     3 CON3 /0.0021156D0/, CON4 /263.83052D0/
C
C
       IF((H-2275000.0D0) - .000001D0)2,2,3
C
    3  RHO    =.1348651420-12
      ASOUND=3413.42933D0
        T     =2713.9566100
        P     =.1260680330-11
      GO TO 100
C
    2  ZZ     = H * CON1
                      AH      = AR * ZZ / (AR & ZZ)
             DO 7 I = 1,26
             IF(AH - HB(I)) 7,8,9
    9        IF(AH - HB(I&1)) 8,7,7
    8                 K       = I
             GO TO 10
C
    7        CONTINUE
C
   10  WS4   =(AH -HB(K))
                      TM      = TB(K) &(BM(K) * (WS4))
      KK=K
      IF(KK.EQ.26)KK=25
      WTM=TWTM(KK)&(AH-HB(KK))*(TWTM(KK&1)-TWTM(KK))/(HB(KK&1)-HB(KK))
        T     =  TM * CON2*(WTM / AMO)
C
   12        IF(BM(K) - 0.D0) 15,16,15
C
   15  WS5   = (TB(K) / TM )
       WS6   = ( AG * AMO / (ARR  * BM(K)))
       RHO   =(R(K) * WS5 **(1.D0 & WS6))/ R(2)
        P    =(PB(K)* WS5 **(WS6) ) * CON3
             GO TO 17
C
   16  WS7   = EXP ( - (  AG * AMO  * WS4)/( ARR * TB(K)))
       RHO   = R(K) * WS7/R(2)
        P    = PB(K)* WS7* CON3
C
   17  CONTINUE
       ASOUND = CON4          * SQRT  ( T / WTM )
  100        RETURN
       END
```

```
CCAVDON
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE DAVDON
      COMMON/IOPT/IPROC,IN,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON/FOPT/ERR,PRAND, FAC1, DELTA1
      COMMON /END/ ITERM
      COMMON/BLKO/ H(40,40),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FO,E, P,TO,RS,SL, Z,Q,A,EL,
     2DELTA,FAC,C(40,10)
      COMMON/SENSE/ISEN1,ISEN2
      COMMON/BLKI/M,N,L,LS,M1,MS,NS,IT,K,NC
C
C
C          SUBROUTINE DAVDON IS THE CONTROLLING SUBROUTINE FOR THE
C        CALCULATIONS OF THE DAVIDON VARIABLE METRIC METHOD OF MINIMI-
C        ZATION, WHICH DETERMINES NUMERICALLY THE LOCAL MINIMA OF
C        DIFFERENTIABLE FUNCTIONS OF SEVERAL VARIABLES.  IN THE PROCESS
C        OF LOCATING EACH MINIMUM, A MATRIX H WHICH CHARACTERIZES THE
C        BEHAVIOR OF THE FUNCTION ABOUT THE MINIMUM IS DETERMINED.
C
C
      FLIM  =0.0D0
      N=IN
      K=IRAND
      FAC = FAC1
      DELTA = DELTA1
      NC=0
      ITLIM=  LIMIT
      E    = ERR
C     VARIABLE METRIC MINIMIZATION
  101 MS=0
      IF(FAC)106,1066,106
  106 DO 1064 I=1,N
      DO 105 J=1,N
  105 H(I,J) =0.0D0
      H(I,I)=FAC
 1064 CONTINUE
      GO TO 109
C
 1066 DO 1068 I=1,N
 1067 DO 1068 J=I,N
 1068 H(J,I)=H(I,J)
C
  109 WRITE(6,5)
      WRITE(6,1)
  111 WRITE(6,6) N, K, E, P, DELTA
  112 WRITE(6,7) (X(I),I=1,N)
  113 WRITE(6,8)
  114 DO 115 I=1,N
  115 WRITE (6,9)(H(I,J),J=1,N)
  116 M1=1
 1165 F=0.0
C
C
  117 CALL FCN(N,G,F,X,M1)
      IF(ITERM.NE.0) GO TO 149
C
 1175 IF(F-FLIM) 1393,1393,118
  118 L=1
```

```
 1185 IT=0
  119 WRITE (6,14)IT,MS,F
 1195 WRITE (6,7)(X(I),I=1,N)
  120 WRITE (6,4)
 1201 IF (NC)121,121,1202
 1202 DO 1209 J1=1,NC
 1203 CALL MATMP (N,N,H,C(1,J1),T)
 1204 CALL MATMP (1,N,T,C(1,J1),TO)
 1205 IF (TO-E)1209,1209,1206
 1206 DO 1208 I=1,N
 1207 DO 1208 J=1,N
 1208 H(I,J)=H(I,J)-T(I)*T(J)/TO
 1209 CONTINUE
C
  121 CALL READY
      IF(ITERM.NE.0) GO TO 149
C
  122 L=L
  123 GO TO (139,159,137,126),L
  124 L=2
  125 GO TO 1201
C
  126 CALL AIM
      IF(ITERM.NE.0) GO TO 149
C
  127 L=L
  128 GO TO (129,135,137),L
C
  129 CALL FIRE
      IF(ITERM.NE.0) GO TO 149
C
  130 L=L
  131 GO TO (135,132,126),L
  132 L=1
C
  133 CALL DRESS
C
      FD= F-FLIM
      IF((FD.LE.0.000).OR.(IT.GT.ITLIM) ) GO TO 142
 1335 L=L
  134 GO TO (124,162),L
  135 L=2
  136 GO TO 133
  137 L=3
  138 GO TO 133
  159 L=4
  161 GO TO 133
  139 IF(ISEN1) 1395,1395,1393
 1393 WRITE (6,7)(X(I),I=1,N)
 1395 CALL STUFF
  140 L=L
  141 GO TO (1165,142),L
  142 WRITE (6,10)
      IF(IT.LE.ITLIM) GO TO 143
      WRITE(6,900) IT
  900 FORMAT(1H /10X,'PROGRAM HAS NOT CONVERGED AFTER', I3,'ITERATIONS'
     1, 1H /)
  143 WRITE (6,11)
  144 DO 145 I=1,N
  145 WRITE (6,9)(H(I,J),J=1,N)
```

```
  146 WRITE (6,13)F,GS
  147 WRITE (6,7)(X(I),I=1,N)
  148 WRITE (6,12)(G(I),I=1,N)
C
C
  149 M1=3
  150 CALL FCN(N,G,F,X,M1)
C
C
  151 IF(ISENL) 152,152, 157
  152 CONTINUE
  156 GO TO 157
    1 FORMAT (72H IDENTIFICATION TITLE
     1                         )
    2 FORMAT (3I6,F6.0)
    3 FORMAT (6D12.5)
    4 FORMAT (20H0- - - - - - - - - - -)
    5 FORMAT (29H1VARIABLE METRIC MINIMIZATION)
    6 FORMAT (3H0N=I2,4H  K=I2,4H  E=1PE14.5,4H  P=E14.5,8H  DELTA=E14.5
     1)
    7 FORMAT (3H0X=1P8E14.5/(3H0  8E14.5))
    8 FORMAT (2H0H)
    9 FORMAT (1H01P8E14.5/(1H08E14.5))
   10 FORMAT (13H0FINAL VALUES)
   11 FORMAT (13H0ERROR MATRIX)
   12 FORMAT (3H0G=1P8E14.5/(3H0  8E14.5))
   13 FORMAT (3H0F=1PE14.5,5H  GS=E14.5)
   14 FORMAT (4H0IT I4,7H  STEP I4,4H  F=1PE14.5)
  157 CONTINUE
  158 CONTINUE
  162 RETURN
      END
```

```
CDEREQ
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE DEREQ(DVAL,ZUSE,DERIV,LL)
C
      REAL*8 MDOT,LAMDA,MINF
C
      DIMENSION ALPTAB(75),CDTAB(75),WHTAB(75),WCDTAB(75),HTAB(75)
      DIMENSION OCCUR(4000),NOCCUR(30),MDOT(4,8)
      DIMENSION DVAL(16),DERIV(16)
C
      EQUIVALENCE
     1(OCCUR(001),AREF   ),(OCCUR(002),ALPHA ),(OCCUR(003),ALPHIM),
     2(OCCUR(016),CD     ),(OCCUR(026),GAMF  ),(OCCUR(032),LAMDA ),
     3(OCCUR(035),MINF   ),(OCCUR(043),P     ),(OCCUR(044),PHI   ),
     4(OCCUR(045),PSI    ),(OCCUR(050),Q     ),
     5(OCCUR(052),RN     ),(OCCUR(053),RB    ),(OCCUR(059),RNDOT ),
     6(OCCUR(060),RBDOT  ),(OCCUR(065),SMR   ),(OCCUR(071),THEALP),
     7(OCCUR(073),TWSTAG),(OCCUR(074),TWO   ),(OCCUR(080),TIMER ),
     8(OCCUR(082),V      ),(OCCUR(084),W     ),(OCCUR(086),WDOT  ),
     9(OCCUR(087),XR     ),(OCCUR(090),XBAR  ),(OCCUR(091),Z     )
      EQUIVALENCE
     1(OCCUR(188),AWREF ),(OCCUR(199),YR    ),(OCCUR(200),PSIALP),
     2(OCCUR(204),WTH   ),(OCCUR(237),XUP   ),
     3(OCCUR(2708), MDOT(1,1)),(OCCUR(3233),HTAB(1)),
     4(OCCUR(3308),WHTAB(1)),(OCCUR(3383),CDTAB(1)),
     5(OCCUR(3458),WCDTAB(1)),(OCCUR(3646),ALPTAB(1))
      EQUIVALENCE
     1(NOCCUR(03),   MOPT),(NOCCUR(05),NOSEOP),(NOCCUR(10), MHEAT),
     2(NOCCUR(18),MAXCD ),(NOCCUR(19),MAXWCD),(NOCCUR(30),INALPH)
C
      COMMON OCCUR,NOCCUR
C
C
C
C        SUBROUTINE DEREQ CALLS IN SUBROUTINES WHICH CALCULATE THE
C     DERIVATIVES INTEGRATED BY SUBROUTINE ADM4RK.
C
C
C        INTERNAL PROGRAM VARIABLES ARE SET EQUAL TO CORRESPONDING
C     INTEGRATED VALUES FROM INTEGRATION SUBROUTINE ADM4RK.
    1 V=DVAL(1)
      GAMF=DVAL(2)
      TIME=DVAL(3)
      Z=ZUSE
      XR=DVAL(4)
      W=DVAL(5)
      RN=DVAL(6)
      RB=DVAL(7)
      PSI=DVAL(8)
      THEALP=DVAL(9)
      PHI=DVAL(10)
      Q=DVAL(11)
      SMR=DVAL(12)
      P=DVAL(13)
      YR=DVAL(14)
      PSIALP=DVAL(15)
      WTH=DVAL(16)
      TIMER=TIME
      IF(Z.LT.0.0D0)GO TO 2
```

```
C
C          SUBROUTINE PRELIM DOES PRELIMINARY CALCULATIONS OF GEOMETRIC,
C       FLOW FIELD, AND THRUSTING PARAMETERS.
   10 CONTINUE
      CALL PRELIM(LL)
      IF(LL.EQ.6)RETURN
C
C          PROGRAM WILL NOT RUN WHEN THE FREE STREAM MACH NUMBER IS
C       LESS THAN 5.
      IF(MINF.GE.5.D0)GO TO 20
      WRITE(6,1001)
 1001 FORMAT(1H0 10X,15HMINF IS LESS THAN 5)
      LL=6
      RETURN
C
C          PROGRAM WILL NOT RUN WHEN THE BLUNTNESS RATIO IS GREATER
C       THAN 0.6.
   20 IF(LAMDA.LE.0.6D0)GO TO 22
      WRITE(6,1002)
 1002 FORMAT(1H0 10X,25HLAMDA IS GREATER THAN 0.6)
      LL=6
      RETURN
   22 CONTINUE
C
C          NO HEATING OR MASS LOSS CALCULATIONS IN RAREFIED FLOW.
C          HEATING AND MASS LOSS CALCULATIONS ARE ONLY PERFORMED IN
C       CONTINUUM FLOW AND IN THE FAIRING REGIME BETWEEN STRONG
C       INTERACTION AND CONTINUUM WHERE XBAR IS LESS THAN XUP.
      IF(XBAR.LT.XUP)GO TO 3
    8 TWSTAG=TWO
      DERIV(5)=0.D0
      DERIV(6)=0.D0
      DERIV(7)=0.D0
      MDOT(2,8)=0.D0
      MDOT(3,8)=0.D0
      GO TO 4
C
C          IF MOPT=0 THE ENTIRE MASS LOSS AND HEATING BLOCK OF EQUATIONS
C       IS BYPASSED.
    3 IF(MOPT.EQ.0)GO TO 6
C
C          SUBROUTINE AERODY PERFORMS AERO. HEATING CALCULATIONS WHEN
C       MOPT = 1.
      CALL AERODY
      IF(MHEAT.EQ.0)GO TO 8
C
C          SUBROUTINE MASSLO CONTROLS THE CALLING OF SUBROUTINE EVIL
C       WHICH CALCULATES MASS LOSS RATES, RECESSION RATES, AND WALL
C       TEMPERATURE.   TOMALO INTEGRATES THE MASS LOSS RATES OVER THE
C       VEHICLE TO OBTAIN THE RATE OF CHANGE IN WEIGHT DUE TO ABLATION.
C          THE VALUE OF THE FOLLOWING DERIVATIVE IS CALCULATED IN TOMALO
C          DERIV(5)=W DOT
      CALL MASSLO
    5 CALL TOMALO
      DERIV(5)=WDOT
C
C          SUBROUTINE NOSEBL CALCULATES VEHICLE SHAPE CHANGE WHEN
C       NOSTOP = 1.  THE VALUES OF THE FOLLOWING DERIVATIVES ARE
C       CALCULATED IN NOSEBL.
    6 IF(NOSTOP.EQ.1)GO TO 7
```

```
      DERIV(6)=0.D0
      DERIV(7)=0.D0
      GO TO 4
    7 CALL NOSEBL
      DERIV(6)=RNDOT
      DERIV(7)=RBDOT
C
C          INALPH= THE NUMBER OF VALUES IN THE INPUT ANGLE OF ATTACK
C       TABLE -- WHEN GREATER THAN ZERO, CAUSES THE BYPASSING OF SUB-
C       ROUTINE ROTATE.
C          SUBROUTINE ROT TE CALCULATES THE ANGLE OF ATTACK BY ONE OF
C       TWO METHODS DEPENDING ON THE VALUE OF THE INPUT LOPT.
C       LOPT = 0 IS AN UNCOUPLED THREE DEGREE OF FREEDOM CALCULATION.
C       LOPT = 2 IS A SIMPLIFIED ANGLE OF ATTACK SOLUTION REQUIRING NO
C       INTEGRATION.
    4 CONTINUE
      IF(INALPH.GT.0.D0) GO TO 17
C
C          ANGLE OF ATTACK IS CALCULATED BY SUBROUTINE ROTATE.
      CALL ROTATE(DERIV,LL)
      IF(LL.EQ.6)RETURN
      GO TO 19
   17 CONTINUE
C          THE ANGLE OF ATTACK IS A TABULAR INPUT
      LLL=-1
      ALPHA=TABLE(Z,HTAB,ALPTAB,INALPH,LLL)/57.29578D0
      ALPRIM=ALPHA
      DO 18 IJ = 8,13
      DERIV(IJ) = 0.D0
   18 CONTINUE
   19 CONTINUE
C
C          SUBROUTINE DRAGCO PERFORMS CALCULATIONS FOR DRAG COEFFICIENTS
C          MAXCD=NUMBER OF VALUES IN THE INPUT DRAG COEFFICIENT TABLE,
C       CDTAB.  IF GREATER THAN ZERO, THE DRAG COEFFICIENT IS READ IN
C       AND SUBROUTINE DRAGCO IS BYPASSED.
      IF(MAXCD.NE.0)GO TO 13
      CALL DRAGCO
      GO TO 14
   13 LLL=-1
      CD=TABLE(Z,HTAB,CDTAB,MAXCD,LLL)
   14 CONTINUE
C
C          MAXWCD=NUMBER OF VALUES IN TABLE OF DRAG  COEFF. INCREMENT,
C       WCDTAB, WHICH IS ADDED TO THE CD OBTAINED FROM EITHER DRAGCO OR
C       INPUT CDTAB.   WCDTAB IS BASED ON THE INPUT CONSTANT REFERENCE
C       AREA AWREF, BUT IS MULTIPLIED BY THE RATIO AWREF/AREF BEFORE
C       BEING ADDED TO CD.
      IF(MAXWCD.EQ.0)GO TO 15
      LLL=-1
      WIRECD=TABLE(Z,WHTAB,WCDTAB,MAXWCD,LLL)
      CD=CD+WIRECD*AWREF/AREF
C
C          SUBROUTINE TEQUAT CALCULATES THE TRANSLATIONAL TRAJECTORY
C       DERIVATIVES.
   15 CONTINUE
      CALL TEQUAT(DERIV)
C
C          THE TIME DEPENDENT DERIVATIVES ARE BEING CHANGED TO ALTITUDE
C       DEPENDENT DERIVATIVES.  DERIV(3) = D(TIME)/D(ALTITUDE).
```

```
      DERIV(1)=DERIV(1)*DERIV(3)                                        DEREQ180
      DERIV(2)=DERIV(2)*DERIV(3)                                        DEREQ181
      DO 16 J=4,16                                                      DEREQ182
   16 DERIV(J)=DERIV(J)*DERIV(3)                                        DEREQ183
      RETURN                                                            DEREQ184
    2 LL=6                                                              DEREQ185
      WRITE(6,1000)Z                                                    DEREQ186
 1000 FORMAT(1H0 10X,14HZ IS NEGATIVE (E12.5,1H))                       DEREQ187
      RETURN                                                            DEREQ188
      END                                                               DEREQ189
```

```
CDIVMLT
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE DIVMLT(A,B,C,D,E,F)
C
C         SUBROUTINE DIVMLT CALCULATES THE REAL AND IMAGINARY COMPO-
C       NENTS OF THE FIRST ORDER NEUMANN FUNCTION USING THE ZEROTH
C       ORDER NEUMANN FUNCTION COMPONENTS.
C
      R=C**2&D**2
      IF (R)1,2,1
    2 E=0.0D0
      F=0.0D0
      GO TO 3
C
    1 CONTINUE
      G=C/R
      H=-D/R
      E=A*G-B*H
      F=A*H&B*G
    3 RETURN
      END
```

```
CDRAGCO
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE DRAGCO
C
      REAL*8 LAMDA,LAMWD,LA,MINF,MDOT,ME,MLSTAR,LAMW
C
      DIMENSION  A(514),B(21),CDFINF(2,2,2),TW(4,8),MDOT(4,8),
     1          OCCUR(4000),NOCCUR(30)
C
      EQUIVALENCE
     1(OCCUR(001),AREF  ),(OCCUR(002),ALPHA ),(OCCUR(003),ALPRIM),
     2(OCCUR(009),CODRAG),(OCCUR(010),CAPL  ),(OCCUR(011),COSLAM),
     3(OCCUR(016),CD    ),(OCCUR(017),CPE   ),(OCCUR(018),CPW   ),
     4(OCCUR(021),D     ),(OCCUR(026),GAMF  ),(OCCUR(028),GAMMA ),
     5(OCCUR(029),HSRTO ),(OCCUR(032),LAMDA ),(OCCUR(033),LA    ),
     6(OCCUR(035),MINF  ),(OCCUR(036),ME    ),(OCCUR(042),PI    ),
     7(OCCUR(048),PE    ),(OCCUR(049),PINF  )
      EQUIVALENCE
     1(OCCUR(055),RHOINF),(OCCUR(056),RHOIN1),(OCCUR(061),RHOE  ),
     2(OCCUR(062),REYL  ),(OCCUR(064),SINT  ),(OCCUR(067),SINTM ),
     3(OCCUR(069),THETAD),(OCCUR(070),TANT  ),(OCCUR(072),TINF  ),
     4(OCCUR(074),TWO   ),(OCCUR(075),T     ),(OCCUR(077),TCRIT ),
     5(OCCUR(078),TECON ),(OCCUR(079),TE    ),(OCCUR(080),TIMER )
      EQUIVALENCE
     1(OCCUR(082),V     ),(OCCUR(083),VE    ),(OCCUR(086),WDOT  ),
     2(OCCUR(089),XBARST),(OCCUR(090),XBAR  ),(OCCUR(091),Z     ),
     3(OCCUR(092),ZTR   ),(OCCUR(093),ZETA  ),(OCCUR(095),GRATE ),
     4(OCCUR(098),CDP   ),(OCCUR(099),CDB   ),(OCCUR(100),CDI   ),
     5(OCCUR(101),CDPO  ),(OCCUR(126),XBAR1 ),(OCCUR(148),TWST  ),
     6(OCCUR(197),FACTR9),(OCCUR(225),HWBAR )
      EQUIVALENCE
     1(OCCUR(234),DELCDP),(OCCUR(235),DECDFP),(OCCUR(236),DECFTC),
     2(OCCUR(237),XUP   ),(OCCUR(238),XLOW  ),(OCCUR(239),X1UP  ),
     3(OCCUR(240),X1LOW ),(OCCUR(246),TZTEST)
      EQUIVALENCE
     1(OCCUR(0301),      A(1)),(OCCUR(0823),     B(1)),
     2(OCCUR(2644),   TW(1,1)),(OCCUR(2708),MDOT(1,1)),
     3(OCCUR(2793),CDFINF(1,1,1))
      EQUIVALENCE
     1 (NOCCUR(03),  MUPT),(NOCCUR(07),  LCPT),(NOCCUR(10), MHEAT)
C
      COMMON OCCUR,NOCCUR
C
C
C
C          SUBROUTINE DRAGCO CALCULATES THE DRAG COEFFICIENT WHEN INPUT
C        DRAG COEFFICIENT OPTION IS NOT USED.
C
C          FREE MOLECULE FLOW REGIME.      XBAR1 ISGREATER THAN OR EQUAL
C        TO X1UP.
C          STRONG INTERACTION FLOW REGIME.  XBAR1 IS LESS THAN X1LOW
C        AND XBAR GREATER THAN OR EQUAL TO XUP.
C          FAIRING REGIME BETWEEN FREE MOLECULE AND STRONG INTERACTION.
C        XBAR1 IS LESS THAN X1UP AND GREATER THAN OR EQUAL TO X1LOW.
C
C
      PEPINF=PE/PINF
      SQRT3=1.7320508075688770D0
      TEMLAM=1.0D0-COSLAM*COSLAM
```

```
      F1K=.9D0&SINTM*(-.119D0&.0108D0*SINTM)
      ALPHAD=180.0D0*ALPHA/PI
C
C         CURVE FIT FOR PRESSURE DRAG COEFF. AT ZERO ANGLE OF ATTACK.
C       THE SET OF COEFFICIENTS UTILIZED IS DETERMINED BY THE VALUE OF
C       THETAD, CONE HALF ANGLE IN DEGREES.
      N=312
      IF(THETAD.GT.20.0D0)GO TO 200
      N=247
      IF(THETAD.GT.10.0D0)GO TO 200
      N=211
  200 X=1.0D0/MINF
      ZZ=1.0D0/THETAD
      Y=LAMDA
      CDPO=0.0D0
      DO 201 I=1,3
      II=I-1
      ISUB1=N&II
      TEMI=X**II
      DO 201 J=1,3
      JJ=J-1
      ISUB2=ISUB1&3*JJ
      TEMJ=1.0D0
      IF(JJ.NE.0)TEMJ=Y**JJ
      DO 201 K=1,4
      KK=K-1
  201 CDPO=CDPO&A(ISUB2&9*KK)*TEMJ*TEMI*ZZ**KK
C
C         CDPLEO IS A SHARP-CONE PRESSURE DRAG COEFFICIENT FOR THE
C       GIVEN THETA.
      CDPLEO=2.0D0*PE/(RHOINF*V*V)
C
C         CALCULATION OF MULTIPLIER WHICH CORRECTS CDP FOR ANGLES OF
C       ATTACK LESS THAN OR EQUAL TO 4 DEGREES.
      IF(DABS(ALPHAD).GT.4.0D0)GO TO 220
      CDLCDO=1.0D0
      IF(ALPHAD.EQ.0.0D0)GO TO 230
      X=THETAD
      Y=DABS(ALPHAD)
      ZZ=LAMDA
      CDLCDO=0.0D0
      DO 202 I=1,4
      II=I-1
      ISUB1=421&II
      TEMI=X**II
      DO 202 J=1,3
      JJ=J-1
      ISUB2=ISUB1&4*JJ
      TEMJ=Y**JJ
      DO 202 K=1,3
      KK=K-1
      TEMK=1.0D0
      IF(KK.NE.0)TEMK=ZZ**KK
  202 CDLCDO=CDLCDO&A(ISUB2&12*KK)*TEMI*TEMJ*TEMK
      IF(CDLCDO.LT.1.0D0)CDLCDO=1.0D0
      GO TO 230
C
C         CALCULATION OF MULTIPLIER WHICH CORRECTS CDP FOR ANGLES OF
C       ATTACK LESS THAN 40 DEGREES BUT GREATER THAN 4 DEGREES.
```

```
  220 TEML=DABS(ALPHAD)
C        IF ANGLE OF ATTACK IS GREATER THAN 40 DEGREES THEN ALPHA OF
C     40 DEGREES IS USED IN CURVE FIT.
      IF(TEML.GT.40.0D0)TEML=40.0D0
      X=DLOG10(THETAD)
      Y=DLOG10(TEML)
      ZZ=LAMDA
      FUN=0.0D0
      DO 222 I=1,4
      II=I-1
      ISUB1=348&II
      TEMI=X**II
      DO 222 J=1,3
      JJ=J-1
      ISUB2=ISUB1&4*JJ
      TEMJ=Y**JJ
      DO 222 K=1,3
      KK=K-1
      TEMK=1.0D0
      IF(KK.NE.0)TEMK=ZZ**KK
  222 FUN=FUN&A(ISUB2&12*KK)*TEMI*TEMJ*TEMK
      IF(FUN.LT.0.0D0)FUN=0.0D0
      CDLCD0=10.0D0**FUN
  230 CONTINUE
C
      CDP=CDP0*CDLCD0
C
      IF(XBAR.LT.XLOW)GO TO 1
C        WHEN XBAR HAS VALUE LESS THAN XLOW, ALL RAREFIED AIR
C     SOLUTIONS ARE BYPASSED AND ONLY CONTINUUM CALCULATIONS ARE
C     PERFORMED.
C
      TEMTSG=TINF*(1.D0&0.5D0*(GAMMA-1.D0)*MINF*MINF)
      TEM = TWST/TEMTSG
      TEM3=DLOG(XBARST)
      SUM=0.0D0
      IF(THETAD.LT.15.0D0)GO TO 204
C
C        SHARP CONE STRONG INTERACTION DRAG COEFF. FOR CONE HALF ANGLE
C     GREATER THAN OR EQUAL TO 15 DEGREES.
      DO 203 I=1,2
      II=I-1
      ISUB1=384&II
      TEM1=TEM3**II
      DO 203 J=1,4
      JJ=J-1
      ISUB2=ISUB1&2*JJ
      TEM2=THETAD**JJ
      DO 203 K=1,2
      KK=K-1
      ISUB=ISUB2&8*KK
  203 SUM=SUM&A(ISUB)*TEM1*TEM2*TEM**KK
      COST=DEXP(SUM)
      GO TO 3
C
C        SHARP CONE STRONG INTERACTION DRAG COEFF. FOR CONE HALF ANGLE
C     LESS THAN 15 DEGREES.
  204 CONTINUE
      DO 2 I=1,2
      II=I-1
```

```
      ISUB1=200&II
      TEM1=TEM3**II
      DO 2 J=1,2
      JJ=J-1
      ISUB2=ISUB1&2*JJ
      TEM2=THETAD**JJ
      DO 2 K=1,2
      KK=K-1
      ISUB=ISUB2&4*KK
    2 SUM=SUM&A(ISUB)*TEM1*TEM2*TEM**KK
      COST=EXP(SUM)
C
C           FREE MOLECULE DRAG COEFFICIENT WITH ACCOMMODATION COEFFICIENT
C        ZETA.
    3 CDF=    EXP(-SINTM*SINTM)
      CDF=CDF*(1.D0/(SINTM*SQRT(PI))&0.5D0*SQRT(TWST/TINF)/(MINF*MINF))
      CDF=CDF&2.D0&1.D0/(MINF*MINF)&SINT*SQRT(PI*TWST  /TINF)/MINF
      CDF=ZETA*CDF
C
C           NEWTONIAN DRAG COEFFICIENT.
      CON=2.D0*SINT*SINT
C
C           CAPP IS THE SHARP CONE PROBABILITY DISTRIBUTION AS A FUNCTION
C        OF KNUDSEN NUMBER.
      LAMW=CODRAG*SQRT(2.25D0*PI*TWST/(GAMMA*TINF))/MINF
      LAMWD=LAMW/D
      IF(LAMWD.LT.0.04D0)GO TO 19
      CAPP=0.D0
      TEM=DLOG(LAMW/D)
      DO 18 I=1,21
   18 CAPP=CAPP&B(I)*TEM**(I-1)
      GO TO 23
   19 CAPP=0.506D0-0.147D0*(DLOG10(0.04D0/LAMWD))
C
   23 CONTINUE
C           SHARP CONE FREE MOLECULE DRAG COEFFICIENT.
      CDTRFM=CAPP*(CDF-CON)&CON
      IF(LAMDA.LT.1.D0-3)GO TO 30
C
C           FREE MOLECULE DRAG COEFF. ON SPHERICAL NOSE
      CDFMS=0.D0
      TEM=DLOG(REYL*D/(CAPL*MINF*FACTR9))
      IF(DABS(TEM).LE.1.D0-4)TEM=1.D0-4
      IF(TEM.GT.5.298D0)TEM=5.298D0
      DO 31 J=1,20
   31 CDFMS=CDFMS&A(J&173)*TEM**(J-1)
      CDFMS=2.D0*CDFMS
C
C           BLUNT CONE FREE MOLECULE TOTAL DRAG COEFFICIENT.
      CDFM=CDFMS*COSLAM*COSLAM&CDTRFM*(1.D0-LAMDA*LAMDA)
      GO TO 32
C
C           SHARP CONE FREE MOLECULE TOTAL DRAG COEFFICIENT.
   30 CDFM=CDTRFM
C
C           BLUNT CONE STRONG INTERACTION DRAG COEFFICIENT.
   32 CDS=(COST-COPLEO)*(1.D0-LAMDA*LAMDA)*COS(ALPRIM)&CDP
      IF(XBAR1.LT.X1UP)GO TO 34
C
C           FREE MOLECULE TOTAL DRAG COEFFICIENT.
```

```
      CD=CDFM
      RETURN
C
   34 IF(XBAR1.GE.X1LOW)GO TO 35
      IF(XBAR.LE.XUP)GO TO 5
C
C           STRONG INTERACTION TOTAL DRAG COEFFICIENT.
      CD=CDS
      RETURN
C
C           FAIRING REGION BETWEEN STRONG INTERACTION AND FREE MOLECULE
C           FLOW
   35 W1=(XBAR1-X1LOW)/(X1UP-X1LOW)
      CD=CDFM*W1&CDS*(1.0D0-W1)
      IF(XBAR.GT.XUP)RETURN
      XUP=XBAR
      XLOW=XBAR-2.0D0
      IF(XBAR.LE.2.0D0)XLOW=0.5D0
      RETURN
C
C
C           CONTINUUM FLOW DRAG CALCULATIONS.
C
C
C           KEY FOR SKIN FRICTION DRAG COEFF. DESCRIPTION
C         SHARP=1            BLUNT=2
C         TURBULENT=1        LAMINAR=2
C         WITH BLOWING=1     NO BLOWING=2
C         CDFINF(SHARP OR BLUNT, LAM. OR TURB., BLOWING OR NO BLOWING)
C
C           BASE DRAG COEFFICIENT.
    1 CONTINUE
    5 Y=DABS(WDOT)/(RHOIN1*V*AREF)
      IF(Y.LT.0.0D0)Y=0.0D0
      IF(Y.GT.0.06D0)Y=0.06D0
      X=1.0D0/MINF
      IF(MINF.GT.24.0D0)X=1.0D0/24.0D0
      N=487
      IF(MINF.GE.7.0D0)N=499
      PBPINF=0.0D0
      DO 8 I=1,4
      II=I-1
      ISUB1=N&II
      TEMI=X**II
      DO 8 J=1,3
      JJ=J-1
      ISUB=ISUB1&4*JJ
      TEMJ=1.0D0
      IF(JJ.NE.0)TEMJ=Y**JJ
    8 PBPINF=PBPINF&A(ISUB)*TEMI*TEMJ
      CDB=(1.0D0-PBPINF)*(X**2)/0.7D0
C
    9 CONTINUE
      IF(XBAR.GE.XLOW)GO TO 10
      IF(Z.GE.ZTR)GO TO 10
C
C           TURBULENT DRAG CALCULATIONS.
C
C           SCHULTZ GRUNOW SKIN FRICTION DRAG COEFFICIENT.
      HE=CPE*TE
```

```
      HSTAHE=0.5D0&0.5D0*CPW*TW(3,8)/HE&0.099D0*ME*ME*(GAMMA-1.0D0)
      HSTAR=HSTAHE*HE
      IF(HSTAR.LE.1110.0D0)GO TO 21
      TEM=PE/2116.0D0
      IF(TEM.GE.1.001)TEM=1.001
      TSTAR=0.0D0
      DO 20 I=1,4
      II=I-1
      ISUB1=162&II
      TEMI=HSTAR**II
      DO 20 J=1,3
      JJ=J-1
      ISUB=ISUB1&4*JJ
   20 TSTAR=TSTAR&A(ISUB)*TEMI*(TEM**JJ)
      GO TO 22
   21 TSTAR=3.5964D0*HSTAR
   22 CONTINUE
      IF(TSTAR.LT.0.D0)CALL EXIT
      MUSTAR=32.2D0*2.27D-8*TSTAR**1.5D0/(TSTAR&198.6D0)
      TAU=TSTAR*(1.0D0-0.125D0*DLOG10(PE/2116.D0))/1.8D0
      ZTAU=2.5D0&0.1D0*DTANH(TAU/500.0D0-7.D0)&0.4D0*DTANH(TAU/1000.D0-
     17.D0)&DTANH(TAU/2500.D0-5.8D0)
      RHOSTA=(39.65D0*PE)/(2116.D0*ZTAU*TSTAR)
C
      IF(CAPL.GE.2.D0)GO TO 12
      A(118)=-4.4666D0
      A(119)=156.D0
      A(120)=-665.D0
      GO TO 13
   12 A(118)=0.D0
      A(119)=0.D0
      A(120)=0.D0
      DO 14 I=1,7
      II=I-1
      TEMI=CAPL**II
      A(118)=A(118)&A(II&400)*TEMI
      A(119)=A(119)&A(II&407)*TEMI
   14 A(120)=A(120)&A(II&414)*TEMI
   13 TEM1=DLOG10(RHOSTA*VE/MUSTAR)
      TEM2=A(120)&TEM1*(A(119)&A(118)*TEM1)
      REYSTA=RHOSTA*VE*CAPL/MUSTAR
C
C        CFO= NO BLOWING SKIN FRICTION COEFF. FOR USE IN MASS LOSS
C          CORRECTION.
      CFO=.3700*1.15D0*RHOSTA*VE*VE/(V*V*RHOIN1*DLOG10(REYSTA)**2.584D0)
      CFO=CFO*RHOIN1*V*V/(RHOE*VE*VE)
      COFINF(1,1,2)=0.5D0*.852D0*VE*VE*RHOSTA/(RHOIN1*TANT*V*V*TEM2)
C
C           BLOWING CORRECTION TO SKIN FRICTION DRAG COEFF.
      COFINF(1,1,1)=COFINF(1,1,2)/(1.D0&1.2D0*MDOT(3,8)/(RHOE*VE*CFO))
C
C           BLUNTNESS CORRECTION TO SKIN FRICTION DRAG COEFF.
      IF(LAMDA.LT.0.32D0)COFINF(2,1,1)=COFINF(1,1,1)*(1.0D0-LAMDA*
     1(0.8D0&0.052D0*MINF))
      IF(LAMDA.GE.0.32D0)COFINF(2,1,1)=COFINF(1,1,1)*(3.764D0-0.01664D0*
     1MINF)
      COFINF(2,1,2)=COFINF(2,1,1)*COFINF(1,1,2)/COFINF(1,1,1)
C
C           INDUCED PRESSURE DRAG COEFFICIENT.
      HW=HWBAR
```

```
      IF((MOPT*MHEAT).EQ.0)HW=0.2400*TWO/33.8600                        DRAGC350
      HR=0.9D0*HSRTO                                                    DRAGC351
      HWHR=HW/HR                                                        DRAGC362
      TEM =RHOE*VE*CFO                                                  DRAGC363
      DTHE1=CFO*(2.0D0*MDOT(3,8)/TEM &1.0DC/(1.0D0&1.2D0*MDOT(3,8)/TEM))DRAGC354
     1/3.8D0                                                            DRAGC365
      DTHE2=DTHE1*(0.547D0*HWHR&ME*(0.53D0&0.68D0*HWHR)&ME*ME*(0.083D0& DRAGC366
     10.106D0*HWHR))                                                    DRAGC357
      DTHE=DTHE2&1.6D0*MDOT(3,8)/(3.6D0*RHCE*VE)                        DRAGC368
      CDLCDP=1.11D0*TEMLAM*CDPLEO*DTHE*F1K*SQRT3*ME                     DRAGC359
      CDI=CDLCDP                                                        DRAGC370
C                                                                       DRAGC371
C             VALUE OF CDSUM FOR FULLY TURBULENT FLOW                   DRAGC372
      CDSUMT=CDFINF(2,1,1)&CDLCDP                                       DRAGC373
      CDSUM=CDSUMT                                                      DRAGC374
      IF(LOPT.GE.3)GO TO 36                                             DRAGC375
      IF(TIMER.GE.TZTEST)GO TO 36                                       DRAGC376
C                                                                       DRAGC377
C             FAIRED VALUE FOR CDSUM BETWEEN LAMINAR AND TURBULENT FLOW DRAGC378
      TEM1 =CFOZTR*LA/1.5D0                                             DRAGC379
      TEM2=CFO*LA**1.6D0/1.8D0                                          DRAGC380
      TEM3=1.0D0-(TIMER-TZTR)/TF                                        DRAGC381
      PBAR=(TEM1*TEM3**1.5D0-TEM2*TEM3**1.8D0)/(TEM1-TEM2)              DRAGC382
      CDI=CDILAM*PBAR&(1.0D0-PBAR)*CDI                                  DRAGC383
      CDFINF(2,1,1)=CDFINF(2,2,1)*PBAR&(1.0DC-PBAR)*CDFINF(2,1,1)       DRAGC384
      CDFINF(2,1,2)=CDFINF(2,2,2)*PBAR&(1.0D0-PBAR)*CDFINF(2,1,2)       DRAGC385
      CDSUM=CDI&CDFINF(2,1,1)                                           DRAGC386
C                                                                       DRAGC387
C             AVERAGE ANGLE OF ATTACK OVER CYCLE USED IN CORRECTING CDP.DRAGC388
   36 CONTINUE                                                          DRAGC389
      IF(TCRIT.LE.T)GO TO 15                                            DRAGC390
      IF(T.LT.TECON)GO TO 15                                            DRAGC391
      CD=CDSUM&CDB&CDPO*(1.0D0&GRATE/T)                                 DRAGC392
      RETURN                                                            DRAGC393
C                                                                       DRAGC394
C             TOTAL TURBULENT DRAG COEFFICIENT                          DRAGC395
   15 CONTINUE                                                          DRAGC396
      CD=CDSUM&CDB&CDP                                                  DRAGC397
      RETURN                                                            DRAGC398
C                                                                       DRAGC399
C                                                                       DRAGC400
C             LAMINAR DRAG CALCULATIONS.                                DRAGC401
   10 HSTAHE=0.5D0&0.5D0*CPW*TW(2,8)/(CPE*TE)&0.0935D0*(GAMMA-1.0D0)*ME*DRAGC402
     1ME                                                                DRAGC403
      REYSTA=REYL                                                       DRAGC404
      CDFINF(1,2,2)=1.53D0*SQRT(PEPINF/REYL)*(VE/V)**1.5D0/TANT         DRAGC405
      CDFINF(1,2,2)=CDFINF(1,2,2)*(HSTAHE*CPE*TE/(.2398D0*TINF))**(-.185DRAGC406
     XD0)                                                               DRAGC407
C            CFO= NO BLOWING SKIN FRICTION COEFF. FOR USE IN MASS LOSS  DRAGC408
C         CORRECTION.                                                   DRAGC409
      CFO=1.15D0*TANT*CDFINF(1,2,2)*RHOIN1*V*V/(1.53D0*RHOE*VE*VE)      DRAGC410
C                                                                       DRAGC411
C             BLOWING CORRECTION TO SKIN FRICTION DRAG COEFF.           DRAGC412
      CDFINF(1,2,1)=CDFINF(1,2,2)/(1.D0&2.000D0*MDOT(2,8)/(RHOE*VE*CFO))DRAGC413
C                                                                       DRAGC414
C             BLUNTNESS CORRECTION TO SKIN FRICTION DRAG COEFF.         DRAGC415
      TEM=DLOG10(REYL)                                                  DRAGC416
      IF(LAMDA.GE.0.2D0)N=472                                           DRAGC417
      IF(LAMDA.LT.0.2D0)N=457                                           DRAGC418
      SUM=0.D0                                                          DRAGC419
```

```
      DO 16 J=1,3
      JJ=J-1
      ISUB1=N&5*JJ
      TEMJ=1.DO
      IF(JJ.NE.0)TEMJ=LAMDA**JJ
      DO 16 I=1,5
      II=I-1
      ISUB=ISUB1&II
   16 SUM=SUM&A(ISUB)*TEMJ*TEM**II
      CDFINF(2,2,1)=CDFINF(1,2,1)*SUM
      CDFINF(2,2,2)=CDFINF(2,2,1)*CDFINF(1,2,2)/CDFINF(1,2,1)
C
C          DELCDP,DECDFP, AND DECFTC ARE RESPECTIVELY THE LAMINAR
C        INDUCED PRESSURE DRAG COEFFICIENT, PRESSURE INDUCED AND TRANS-
C        VERSE CURVATURE INDUCED SKIN FRICTION DRAG COEFFICIENTS.
      HW=HWBAR
      IF((MOPT*MHEAT).EQ.0)HW=0.24DO*TW(2,8)/33.86DO
      HR=0.9DO*HSRTO
      TEM =RHOE*VE*CFO
      DTHE1=CFO*(2.0DO*MDOT(2,8)/TEM&1.0DO/(1.0DO&1.25DO*MDOT(2,8)/TEM))
     1/(2.0DO*SQRT3)
      FME2=ME*ME
      HWHR=HW/HR
      DTHE2=DTHE1*(A(283)&A(284)*FME2&HWHR*(A(285)&A(286)*FME2&HWHR*(
     1A(287)&A(288)*FME2&HWHR*(A(289)&A(290)*FME2))))
      DTHE=DTHE2&MDOT(2,8)/(3.0DO*RHOE*VE)
      DELCDP=1.33DO*TEMLAM*CDPLEO*DTHE*F1K*SQRT3*ME
      DECDFP=1.5DO*DTHE*TEMLAM            *CDFINF(1,2,2)*F1K
     1*(-0.823DO&0.524DO*TW(2,8)/TE&0.438*FME2)/(ME*SQRT(CAPL))
      DINF=0.058DO&0.968*TW(2,8)/(TINF*MINF*MINF)
      DECFTC=1.5DO*(0.517DO&0.913DO*TW(2,8)/TE&0.0484DO*FME2)
     1*TEMLAM*DTHE*CDFINF(1,2,2)/(FME2*TANT*DINF*SQRT(3.0DO*CAPL))
      CDI=DELCDP&DECDFP&DECFTC
C
      IF(LOPT.GE.3)GO TO 4
C
C          DEFINING QUANTITIES USED IN FAIRING BETWEEN LAMINAR AND
C        TURBULENT FLOW REGIMES.
      CFOZTR=CFO
      TZTR=TIMER
      TF=1.0DO/(0.48667D-4*V*DABS(SIN(GAMF)))
      CDILAM=CDI
      TZTEST=TZTR&TF
    4 CONTINUE
C
      IF(XBAR.GE.XLOW)GO TO 33
      IF(TCRIT.LE.T)GO TO 17
      IF(T.LT.TECON)GO TO 17
C
C          AVERAGE ANGLE OF ATTACK OVER CYCLE USED IN CORRECTING CDP.
      CD=CDB&CDI&CDFINF(2,2,1)&CDPO*(1.DO&GRATE/T)
      RETURN
C
C          FULLY LAMINAR FLOW.
   17 CD=CDB&CDI&CDFINF(2,2,1)&CDP
      RETURN
C
C          FAIRING BETWEEN STRONG INTERACTION AND LAMINAR FLOW.
   33 CDLAM=CDB&CDI&CDP&CDFINF(2,2,1)
      W2=(XBAR-XLOW)/(XUP-XLOW)
```

```
      CD=CDS*W2&CDLAM*(1.0D0-W2)                                        DRAGC480
      RETURN                                                            DRAGC481
      END                                                               DRAGC482
```

```
CDRESS
      SUBROUTINE DRESS
        IMPLICIT REAL*8 (A-H,O-Z)
       COMMON/BLKO/ H(40,40),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FG,E, P,TO,RS,SL, Z,D,A,EL,
     2DELTA,FAC,C(40,10)
       COMMON/SENSE/ISEN1,ISEN2
       COMMON/BLKI/M,N,L,LS,M1,MS,NS,IT,K,NC
C
C
C          SUBROUTINE DRESS, PART OF THE DAVIDON MINIMIZATION METHOD,
C        MODIFIES THE METRIC MATRIX H ON THE BASIS OF INFORMATION
C        OBTAINED ABOUT THE FUNCTION ALONG THE DIRECTION UNDER CONSIDER-
C        ATION, S. THE NEW H MUST RETAIN THE INFORMATION WHICH THE
C        PRECEDING ITERATIONS HAVE GIVEN ABOUT THE FUNCTION.
C
C
      L=L
      GO TO (500,525,519,510),L
  500 CALL MATMP (N,N,H,G,X)
  501 M=1
  502 CALL MATMP (M,N,X,G,TO)
  503 TP1=SL-GSS**2/TO-E
  504 IF (TP1)524,505,505
  505 DO 507 I=1,N
  506 DO 507 J=1,N
  507 H(I,J)=H(I,J)-X(I)*X(J)/TO
  508 DELTA=DELTA*(EL*GSS/TO)
  509 TO=EL/GSS
C
C
  510 DO 512 I=1,N
  511 DO 512 J=1,N
  512 H(I,J)=H(I,J)&TO*S(I)*S(J)
C
C
  519 F=FB
  520 DO 522 I=1,N
  521 G(I)=GB(I)
  522 X(I)=T(I)
  529 CALL OVERFL(LCP021)
      GO TO (531,530,530),LCP021
  530 CALL OVERFL(LCP021)
      GO TO (531,513,513),LCP021
  513 WRITE (6,1)IT,MS,F,GS
  514 IF(ISEN1) 513,515, 517
  515 WRITE (6,2)(X(I),I=1,N)
       WRITE(6,7)
       DO 101 I = 1,N
  101  WRITE(6,8) (H(I,J),J=1,N)
  516 WRITE (6,3)DELTA
  517 WRITE (6,4)
  518 IT=IT&1
 5165 L=1
C
  523 RETURN
C
  524 WRITE (6,5)
C
```

```
  525 TP1=EL*SL/GSS                                                    DRESS 60
  526 DELTA=DELTA*TP1                                                  DRESS 61
  527 TO=(TP1-1.0)/SL                                                  DRESS 62
  528 GO TO 510                                                        DRESS 63
C                                                                      DRESS 64
  531 WRITE (6,6)                                                      DRESS 65
  532 WRITE (6,7)                                                      DRESS 66
  533 DO 534 I=1,N                                                     DRESS 67
  534 WRITE (6,8)(H(I,J),J=1,N)                                        DRESS 68
  535 WRITE (6,9)F                                                     DRESS 69
  536 WRITE (6,2)(X(I),I=1,N)                                          DRESS 70
  537 WRITE (6,10)(G(I),I=1,N)                                         DRESS 71
      IF(ISEN1) 539,539, 543                                           DRESS 72
  539 CONTINUE                                                         DRESS 73
  543 L=2                                                              DRESS 74
  544 GO TO 523                                                        DRESS 75
C                                                                      DRESS 76
    1 FORMAT (4H0IT I4,7H  STEP I4,4H  F=1PE14.5,5H  GS=E14.5)         DRESS 77
    2 FORMAT (3H0X=1P8E14.5/(3H0  8E14.5))                             DRESS 78
    3 FORMAT (7H0DELTA=1PE14.5)                                        DRESS 79
    4 FORMAT (20H0- - - - - - - - - -)                                 DRESS 80
    5 FORMAT (9H0COLINEAR)                                             DRESS 81
    6 FORMAT (9H0OVERFLOW)                                             DRESS 82
    7 FORMAT (13H0ERROR MATRIX)                                        DRESS 83
    8 FORMAT (1H01P8E14.5/(1H08E14.5))                                 DRESS 84
    9 FORMAT (3H0F=1PE14.5)                                            DRESS 85
   10 FORMAT (3H0G=1P8E14.5/(3H0  8E14.5))                             DRESS 86
   11 FORMAT (6E12.5)                                                  DRESS 87
      END                                                              DRESS 88
```

```
CDRLIM
      REAL * 8  R(2) , A(2)
      COMPLEX  *16  C , C2
      SUBROUTINE DRLIM(C,R )
       EQUIVALENCE  (C2 , A )
C
C        SUBROUTINE DRLIM TAKES THE REAL AND IMAGINARY PARTS OF A
C      COMPLEX NUMBER AND SETS THEM EQUAL TO TWO REAL NUMBERS.
C
       C2 = C
     R (1) = A(1)
     R (2) = A(2)
       RETURN
    END
```

```
CEFFECT
CEFFECT JUNE 3
      SUBROUTINE EFFECT
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON OCCUR,NOCCUR
      COMMON /CICCUR/ IOCCUR(320)
      COMMON /CPCCUR/ PCCUR(11770)
      DIMENSION IOP(90), NOCCUR(30), OCCUR(4000)
       DIMENSION  SRS(9)
       DIMENSION  DUMMY(100)
      EQUIVALENCE (IOCCUR(00001), IOP   )
      EQUIVALENCE (PCCUR(11757), PFD    )
      EQUIVALENCE (PCCUR(11758), HDIF   )
      EQUIVALENCE (OCCUR(3962), PD     )
       EQUIVALENCE (PCCUR(11598), SRS    )
       EQUIVALENCE (OCCUR(3901), DUMMY )
      EQUIVALENCE (OCCUR(03965), SIGMA)
      DATA A, CON, EPS, B / .7071067811865475, .05D0, .0000100,
     * .0227501319481791) /
C
C
C          SUBROUTINE EFFECT CALCULATES THE QUANTITY PD, WHICH IS THE
C        PROBABILITY THAT A DECOY WILL BE DISCRIMINATED AS BEING A
C        DECOY.
C
C
      PD = 0.D0
C
       DO 11  I = 1, 9
       IF (I.GT.3) GO TO 5
      IF(IOP(I&3).EQ.1)PD=PD&SRS(I)*OCCUR(I&3952)
       GO TO 11
5      IF(IOP(I&24).EQ.1) PD = PD&SRS(I)*OCCUR(I&3952)
11    CONTINUE
C
      PD = DSQRT(PD/HDIF)
      SIGMA = PD
C
C
C
      TOLD = -2.D0
      Y = B
      K = 0
10    K = K & 1
      TX = A*(TOLD & DABS(TOLD)*CON)
      Z = .5D0*(1.D0 & DERF(TX))
      TNEW = TOLD -CON*DABS(TOLD)*(Y-PFD)/(Z-Y)
      W = .5D0*(1.D0&DERF(A*TNEW))
      IF(DABS(W-Y).LE.EPS*DABS(W)) GO TO 99
       IF(K.EQ.20) GO TO 90
      TOLD = TNEW
      Y = W
      GO TO 10
   90  PD = 1.0D0
      WRITE(6,100)
       RETURN
99    CONTINUE
C
C
```

```
C                                                                       EFFEC 60
      PD = .5D0 * (1.0D0 & DERF(A*(TNEW & PD)))                         EFFEC 61
C                                                                       EFFEC 62
      RETURN                                                            EFFEC 63
  100 FORMAT(1H0, 16HERROR IN EFFECT   )                                EFFEC 64
      END                                                               EFFEC 65
```

```
CEVIL
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE EVIL(ZZ)
C
      REAL*8 MDOT,NST,MDTWR,K1,K2,LBAR
C
      DIMENSION OCCUR(4000),NOCCUR(30),TW(4,8),QDOT(4,8),MDOT(4,8)
C
      EQUIVALENCE
     1(OCCUR(004),BETA1 ),(OCCUR(005),BETA2 ),(OCCUR(006),BETA3 ),
     2(OCCUR(007),BETA4 ),(OCCUR(014),CP2   ),(OCCUR(022),DELRHO),
     3(OCCUR(024),EPSIL ),(OCCUR(025),F     ),(OCCUR(029),HSRTJ ),
     4(OCCUR(030),HREF  ),(OCCUR(031),HS    ),
     5(OCCUR(040),NST   ),(OCCUR(047),PS    ),(OCCUR(058),RHO2  ),
     6(OCCUR(048),SPD   ),(OCCUR(074),TW1   ),(OCCUR(091),Z     ),
     7(OCCUR(092),ZTR   ),(OCCUR(132),TINIT ),
     8(OCCUR(190),FACTR2),(OCCUR(191),FACTR3),(OCCUR(192),FACTR4),
     9(OCCUR(193),FACTR5),(OCCUR(194),FACTR6),(OCCUR(195),FACTR7)
      EQUIVALENCE
     1(OCCUR(225),HWBAR ),(OCCUR(2644),TW(1,1)),
     2(OCCUR(2676),QDOT(1,1)),(OCCUR(2708),MDOT(1,1))
      EQUIVALENCE
     1(NOCCUR(01),JJHOLD),(NOCCUR(02),KKHOLD),(NOCCUR(13),MATLNO)
C
      COMMON OCCUR,NOCCUR
C
C
C
C
C        SUBROUTINE EVIL CALCULATES THE MASS LOSS RATE - MDOT, THE
C      WALL RECESSION RATE - SDOT, AND THE WALL TEMPERATURE - TW FOR
C      THE BODY STATIONS AT WHICH AERODYNAMIC HEATING RATES WERE
C      OBTAINED IN SUBROUTINE AERODY.   THE METHOD OF CALCULATION
C      IS DEPENDENT ON THE MATERIAL BEING CONSIDERED.   FOR LEWR IN
C      TURBULENT FLOW ONLY,LTALPHA, TEFLON, AND THE INPUT MATERIAL IN
C      LAMINAR AND TURBULENT FLOW AN ITERATIVE STEADY STATE SOLUTION
C      IS USED.   OTWR IN LAMINAR FLOW, CARBON PHENOLIC, AND PHENOLIC
C      NYLON UTILIZE CURVE FITS OF MDOT AND SDOT AS A FUNCTION OF
C      COLD WALL HEATING FROM AERODY, AND TW AS A FUNCTION OF SDOT.
C
C
C        THE STEADY STATE ABLATION METHOD WHICH ENTAILS ITERATIVE
C      SOLUTIONS OF SIMULTANEOUS EQUATIONS FOR THE SURFACE TEMPERATURE
C      AND THE WALL RECESSION RATE.    IT INCLUDES THE FOLLOWING ENERGY
C      CONSIDERATIONS - CONVECTIVE ENERGY, CONDUCTION FLUX, AND
C      SURFACE RADIATION LOSS, AND SUBLIMATION ENERGY.
      J=JJHOLD
      K=KKHOLD
      ICOUNT=0
      IF(J.NE.2)GO TO 12
      TW(1,K)=TW(2,K)
      TW(4,1)=TW(2,1)
   12 CONTINUE
      IF(MATLNO.LT.3)GO TO 14
      IF(MATLNO.EQ.4)GO TO 52
      IF(MATLNO.GE.6)GO TO 14
      IF(Z.GT.ZTR)GO TO 52
   14 CONTINUE
      ZZ=TW(J,K)
      CS=0.0506*TW(J,K)+25000.D0/TW(J,K)
```

```
    1 ICOUNT=ICOUNT&1
      TEM=DLOG(BETA2*ZZ**BETA3)-BETA4/ZZ
      SPD=BETA1*ZZ&EXP(TEM)
      TK1=FACTR2-1.1112D5/ZZ
      K1=EXP(TK1)
      PBAR=PS/2117.D0
      IF(K1.LT.(1.0D-36))K1=0.CD0
      K2=SQRT(12.7657D0*K1*K1&4.D0*K1*2.9934D0*(K1&4.D0*PBAR)*(FACTR3))
      K2=K2-12.7657D0*K1
      K2=0.5D0*K2/(K1&4.CD0*PBAR)
      GAM1=13.654D0&469.585D0*K2
      GAM2=0.25601 2D0&C.5558D-2*K2
      GAM3=0.5345D-5-0.427D-6*K2
      HWBAR=GAM1&ZZ*(GAM2&GAM3*ZZ)
      HWBAR=HWBAR/33.86D0
      E1BAR=HWBAR/35.E9D0
      XCOM=0.349D0*HSRTO
      E2BAR=(XCOM&C.5D0*HWBAR)/(XCOM&17.945D0)
      E3BAR=0.95D0-(HWBAR-HREF)/HSRTO
      IF(JJHOLD.EQ.2)GO TO 2
      IF(JJHOLD.GE.3)GO TO 3
      E1=-0.C370C
      E2=0.DC
      GO TO 4
    2 E1=0.D0
      E2=-0.185D0
      GO TO 4
    3 E1=0.D0
      E2=-0.502DC
    4 QDOTCF=QDOT(JJHOLD,KKHOLD)*(E1BAR**E1)*(E2BAR**E2)
      IF(QDOTCF.LE.0.CDC)GO TO 77
      TEM=ZZ-TINIT
      IF(Z.GE.ZTR)FBAR=SPD*HS*FACTR6/QDOTCF
      IF(Z.LT.ZTR)FBAR=SPD*HS*FACTR7/QDOTCF
      PHIB=EXP(-FBAR*(1.D0&C.618D0*FBAR))
      QDOTT=0.47583D-12*EPSIL*ZZ**4
      QDOTC=QDOTCF*E3BAR*PHIB
      IF(MATLNO.EQ.5)GO TO 55
      QDOTS=SPD*RHO2*F
      LBAR=SPD*(TEM*FACTR4&FACTR5)
      RBAR=QDOTC-QDOTT-QDOTS
      ARGU=LBAR-RBAR
   51 CONTINUE
      IF(ICOUNT.GT.100)GO TO 50
    5 IF(DABS(ARGU).LT.1.0DC)GO TO 50
    6 IF(DABS(ARGU).LT.DABS(0.01D0*LBAR))GO TO 50
    7 IF(ARGU)8,50,9
    8 IF(DS)11,50,10
    9 IF(DS)10,50,11
   11 DS=-0.5D0*DS
   10 ZZ=ZZ&DS
      GO TO 1
   50 ZZ=DMAX1(ZZ,0.0D0)
   77 IF(QDOTCF.LE.0.0DC)SPD=C.0D0
      SPD=DMAX1(SPD,0.CD0)
      QDOT(J,K)=SPD*(RHO2&DELRHO)
      RETURN
C
C
   52 IF(MATLNO.EQ.5)GO TO 54
```

```
C
C          QTWR CALCULATIONS FOR LAMINAR FLOW
      QDOTCW=QDOT(JJHOLD,KKHOLD)
      IF(QDOTCW.LT.1.7D1)GO TO 56
      IF(QDOTCW.LT.1.56D1)GO TO 58
      IF(QDOTCW.LT.2.5D2)GO TO 59
      IF(QDOTCW.LT.3.0D3)GO TO 62
      MDOT(J,K)=QDOTCW*(1.0D0-1.5D3/HS)/(3.64D3&8.1D0*HSRTO)
      GO TO 57
   62 MDOT(J,K)=-1.05650025D-3&7.61118599D-5*QDOTCW&3.342517000-8*QDOTCW
     1**2-6.91682422D-12*QDOTCW**3
      GO TO 57
   56 MDOT(J,K)=0.0D0
      GO TO 57
   58 MDOT(J,K)=0.00210D&0.00015D0*(QDOTCW-13.0D0)
      GO TO 57
   59 MDOT(J,K)=-1.27424335D-3&1.36071670D-4*QDOTCW-1.09991516D-6*QDOTCW
     1**2&7.98275747D-9*QDOTCW**3-1.65210579D-11*QDOTCW**4
   57 MOTWR=MDOT(J,K)
      IF(QDOTCW.LT.1.0D3)GO TO 75
      IF(QDOTCW.LT.3.0D3)GO TO 72
      SPD=MOTWR/(RHO2&DFLRHO)
      GO TO 73
   75 SPD=1.6115D-6*QDOTCW-5.23741D-4
      GO TO 73
   72 SPD=-1.11196760D-4&4.03376715D-7*QDOTCW&9.70131261D-10*QDOTCW**2-
     12.45527504D-13*QDOTCW**3
   73 IF(SPD.LT.1.0D-13)SPD=1.0D-13
      SOTWR=SPD
      IF(MATLNO.EQ.4)GO TO 53
      SPDL=DLOG10(SPD)
      IF(SPDL.LT.-1.2583D1)SPDL=-12.583D0
      ZZ=6.34634512D3&5.50628796D2*SPDL&1.96585366D1*SPDL**2
      IF(ZZ.GT.4.85D3)ZZ=4850.0D0
      RETURN
C
C          PHENOLIC NYLON CALCULATIONS
   53 CONTINUE
      QDOTCW=QDOT(JJHOLD,KKHOLD)
      QDOTCW=DMAX1(QDOTCW,0.0D0)
      IF(QDOTCW.LE.1.0D2)GO TO 60
      IF(QDOTCW.GT.3.0D3)GO TO 74
      MDOT(J,K)=-1.62367647D-3&1.78922793D-4*QDOTCW&1.32113696D-8*
     1QDOTCW**2-5.08747513D-12*QDOTCW**3
      GO TO 61
   60 MDOT(J,K)=10.0D0**(-2.52288D0&7.3759D-3*QDOTCW)
      GO TO 61
   74 MDOT(J,K)=QDOTCW*(1.0D0-1.7D3/HS)/(1.845D3&1.1D1*HSRTO)
   61 CONTINUE
      IF(MDOT(J,K).LT.1.0D-4)MDOT(J,K)=0.0D0
      IF(MOTWR.LT.1.0D-5)MOTWR=1.0D-5
C          PHENOLIC NYLON SDOT IS RATIOED FROM CTWR SDOT
      SPD=(SOTWR*MDOT(J,K))/MOTWR
      IF(SPD.LT.1.0D-5)SPD=1.0D-5
      SPDL=DLOG10(SPD)
      IF(SPD.LT.1.0D-4)GO TO 76
      ZZ=6.94474035D3&6.45367146D2*SPDL-1.48589173D2*SPDL**2
      IF(ZZ.GT.4.85D3)ZZ=4850.0D0
      RETURN
   76 ZZ=250.0D0&1756.0D0*(SPDL&5.0D0)
```

```
      RETURN
C
C             CARBON PHENOLIC CALCULATIONS FOR LAMINAR FLCW
   54 CONTINUE
      QDOTCW=QDOT(JJHOLD,KKHOLD)
      IF(QDOTCW.LT.8.0D0)GO TO 64
      IF(QDOTCW.LT.1.13D1)GO TO 65
      IF(QDOTCW.LT.2.31D1)GO TO 66
      IF(QDOTCW.LE.1.CD3)GO TO 67
      MDOT(J,K)=1.2328400D-2&3.3C858843D-5*QDOTCW&4.60267808D-9*QDOTCW*
     1*2
      GO TO 68
   64 MDOT(J,K)=C.0D0
      GO TO 68
   65 MDOT(J,K)=6.5788D-4-1.55773D-4*QDOTCW&9.94850-6*QDCTCW**2
      GO TO 68
   66 MDOT(J,K)=1.1D-4&5.78C22D-5*(QDCTCW-1.13D1)
      GO TO 68
   67 MDOT(J,K)=-1.73043255D-3&1.25965766D-4*QDCTCW-8.56939032D-8*QDOTCW
     1**2&4.65548312D-12*QDOTCW**3
   68 CONTINUE
      IF(QDOTCW.LT.2.47D1)SPD=1.CD-18
      IF(QDOTCW.LT.2.47D1)GO TO 69
      IF(QDOTCW.LT.2.75D2)GO TO 70
      IF(QDOTCW.LT.1.CD3)GO TO 71
      SPD=-3.196484D-4&2.865D-7*QDOTCW&2.171792D-10*QDCTCW**2
      GO TO 69
   70 SPD=-2.12296559D-6&1.18955951D-7*QDOTCW&1.40098706D-10*QDOTCW**2
      GO TO 69
   71 SPD=7.66757321D-5-4.55633115D-7*QDOTCW&1.55581653D-9*QDOTCW**2
     1-8.49215390D-13*QDOTCW**3
   69 CONTINUE
   63 SPDL=DLOG10(SPD)
      ZZ=6.68741134D3&4.46431845D2*SPDL&1.20991623D1*SPDL**2
      IF(ZZ.GT.6.16D3)ZZ=616C.0D0
      RETURN
C
C             CARBON PHENOLIC CALCULATIONS FOR TURBULENT FLCW
   55 CONTINUE
      QDNET=QDOTC-QDOTT
      ABAR=C22*(616C.0D0-TWO)&F
      HBAR=HST
      QSTAR=ABAR&BBAR*HSRTO
      MDOT(J,K)=QDNET/QSTAR
      IF(QDNET.LT.0.0D0)MDOT(J,K)=C.0D0
      SPD=(1.8D0*MDOT(J,K))/RHO2
      IF(SPD.LE.1.CD-10)SPD=1.CD-10
      SPDL=DLOG10(SPD)
      IF(SPDL.LT.-1.805D01)SPDL=-18.05D00
      ZZ=6.68741134D3&4.46431845D2*SPDL&1.20991623D1*SPDL**2
      RETURN
      END
```

```
CFCN
      SUBROUTINE FCN(N,G,F,X,M1)
        IMPLICIT REAL*8 (A-H,O-Z)
      COMMON /CIOCUR/ IOCCUR(320)
      COMMON/BLK1/ISO(5),MS,ISO1(6)
      COMMON /END/ ITERM
      COMMON/DOPT/DELX(20)
      COMMON OCCUR, NOCCUR
      DIMENSION X(40),G(40),F0(40)
      DIMENSION OCCUR(4000), NOCCUR(30)
      DIMENSION IOP(96),NPLOT(5),NPSAVE(14)
      EQUIVALENCE(NOCCUR(14),NPRINT), (NOCCUR(24), NPLOT(1))
      EQUIVALENCE (IOCCUR([illegible]), IOP    )
C
C
C           SUBROUTINE FCN MUST COMPUTE THE FUNCTION F AND THE GRADIENT
C        VECTOR G (I.E., THE VECTOR WHOSE ELEMENTS ARE THE FIRST
C        PARTIAL DERIVATIVES OF F WITH RESPECT TO THE PARAMETERS ),
C        GIVEN THE N COORDINATES OF THE POINT X.
C
C
      DO 416 I = 1, 6
      NPSAVE(I) = IOP(I&63)
      IF(I.LT.6)NPSAVE(I&6)=NPLOT(I)
416   IF(I.LT.4)NPSAVE(I&11)= IOP(I)
C
      IF(M1.NE.3) GO TO 5
C
      NPRINT = 1
      CALL FEV(N,X,F)
      NPRINT = 0
      GO TO 106
C
    5 CALL FEV(N,X,F)
      IF(ITERM.NE.0) GO TO 106
C
      DO 417 I = 1, 6
      IOP(I&63) = 0
      IF(I.LT.6) NPLOT(I) = 0
417   IF(I.LT.4) IOP(I) = 0
   10 DO 105  I=1,N
      X(I)=X(I)&DELX(I)
      CALL FEV(N,  X, FM)
      IF(ITERM.NE.0) GO TO 106
      G(I) = (FM -F)/DELX(I)
      X(I)=X(I)-DELX(I)
  105 CONTINUE
C
106   DO 418 I = 1, 6
      IOP(I&63) = NPSAVE(I)
      IF(I.LT.6) NPLOT(I) = NPSAVE(I&6)
418       IF(I.LT.4) IOP(I) = NPSAVE(I&11)
C
      IF(M1. NE. 1) GO TO 1000
      IRC=1
      IC=1
 1000 WRITE(6,915) IC, MS , F, (X(I),I=1,N)
C
  915 FORMAT(1H /10X,'PRINT FCN',5X, 'PASS',I5, 5X,'RANDOM STEP',I5,5X
```

```
     1'F=',1PE20.8/ 9X 'X' 1P5F20.8/3(10X,1P5F20.8/))
      WRITE(6,916) (G(I),I=1,N)
  916 FORMAT(1H0 9X 'G' 1P5F20.8/(1H 10X 1P5F20.8))
      IC=IC&1
      RETURN
      END
```

```
CFEV
      SUBROUTINE FEV(N,X,VAL)
        IMPLICIT REAL*8 (A-H,O-Z)
      COMMON /IDNOS/ ID1(50), ID2(50)
      COMMON OCCUR, NOCCUR
      COMMON/IOPT/IPROC,IN,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON/MIN/ALOW(20),UP(20), AMULT(20),CALOW(20),CUP(20)
      COMMON/CCPN/D
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      COMMON/END/ITERM
      DIMENSION X(20), PNLTY(20)
      DIMENSION OCCUR(4000), NOCCUR(30)
      EQUIVALENCE(OCCUR(4000),LP)
      EQUIVALENCE (NOCCUR(14),NPRINT)
C
C
C          SUBROUTINE FEV EVALUATES THE PENALTY FUNCTION WHICH IS BEING
C        OPTIMIZED FOR THE POINT DESCRIBED BY THE N VALUES OF THE X
C        ARRAY.
C
C
      ITERM=0
      VAL =0.0D0
C
      DO 10  I=1,N
      IZ=ID1(I)
      OCCUR(IZ)=X(I)
   10 CONTINUE
C
      IF(ICOM(1).NE.1) GO TO 15
      CALL CLASSC(VAL)
      GO TO 22
C
15    CALL  SCREEN(N,X,ISUC,VAL,D)
      IF(ISUC.LT. 0) GO  TO 100
C
C
C     CALL  F123(VAL)
C
C
      IF(LP.LT.6) GO TO 20
      ITERM = 1
      GO TO 100
C
   20 CALL MISC (N,X,VAL)
      CALL  EFFECT
C
C
C
   22 IF(NCONS.EQ.0)GO TO 100
      WRITE(6,1000)
 1000 FORMAT(1H0'  IZ'4X'LOWER BOUND'4X'UPPER BOUND'6X'OCCUR(IZ)'8X
     1'PENALTY')
C
C
      DO 50 I=1,NCONS
      PNLTY(I) = 0.0D0
      IZ=  ID2(I)
      IF(OCCUR(IZ).GT.CALOW(I))   GO TO 25
```

```
      PNLTY(I) = AMULT(I)*DABS(OCCUR(IZ)-CALOW(I))**IEX
      WRITE(6,1100) IZ,CALOW(I),CUP(I),OCCUR(IZ),PNLTY(I)
      GO TO 50
   25 IF(OCCUR(IZ).LT.CUP(I)) GO TO 27
      PNLTY(I) = AMULT(I)*DABS(OCCUR(IZ)-CUP(I))**IEX
27    WRITE(6,1100) IZ,CALOW(I),CUP(I),OCCUR(IZ),PNLTY(I)
1100  FORMAT(1H I4, 1P4E15.7)
   50 VAL = VAL & PNLTY(I)
C
C
      F = VAL
      IF(VAL.GT.0.0D0)GO TO 100
      ITERM= -1
C
  100 CONTINUE
      WRITE(6,900) VAL, (X(I), I=1,N)
C
900   FORMAT(1H '*FEV*'2X'F ='1PE15.7,' X ='5E15.7/(1H 29X1P5E15.7))
  999 RETURN
      END
```

```
CFIB1
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE FIB1  (AA,BB,NF,NMIMAX,ACCUR,NFUNC,XMIMAX,YMIMAX)
C
C
C        SUBROUTINE FIB1  UTILIZES A FIBONACCI SEARCH TECHNIQUE TO
C      FIND THE MAXIMUM OR MINIMUM OF A ONE VARIABLE UNIMODAL
C      FUNCTION WITHIN A DEFINED REGION (AA,BB).
C
C
      IW=6
      DIMENSION F(40)
       ITERM = 0
      A=AA
      B=BB
      IF (NMIMAX) 10,11,11
   10 JMIMAX=1
      GO TO 20
   11 JMIMAX=2
   20 IF (B-A) 21,22,23
   21 TEMP=A
      A=B
      B=TEMP
      GO TO 23
   22 L=1
   25 WRITE (IW,26) L
   26 FORMAT(17H0  ERROR OF TYPE  I2)
      ITERM = 1
      GO TO 170
   23 R=B-A
      IF (NFUNC) 31,30,35
   30 IF (ACCUR) 31,31,40
   31 L=2
      GO TO 25
   35 NFUNC2=NFUNC&2
      R1=(1.0D0&SQRT (5.0D0))/2.0D0
      R2=(1.0D0-SQRT (5.0D0))/2.0D0
      ROACC=(R1**NFUNC2-R2**NFUNC2)/(R1-R2)
      GO TO 45
   40 ROACC=R/ACCUR
   45 IF (ROACC-2.0D0) 50,50,51
   50 XMIMAX=(A&B)/2.0D0
       YMIMAX = FUN1(XMIMAX,NF)
      GO TO 170
   51 IF (ROACC-3.0D0) 60,60,61
   60 XL=A&(B-A)/3.0D0
      XR=A&2.0D0*(B-A)/3.0D0
       YL = FUN1(XL,NF)
      IF(ITERM.NE.0) GO TO 160
       YR = FUN1(XR,NF)
      IF(ITERM.NE.0) GO TO 150
      IF(YL-YR) 70,70,71
   70 XMIMAX=XR
      YMIMAX=YR
      GO TO 170
   71 XMIMAX=XL
      YMIMAX=YL
      GO TO 170
   61 K=3
```

```
      E(1) = 1.000
      E(2)=1.000
   74 E(K)=E(K-1)&E(K-2)
      IF (RDACC-E(K)) 80,80,75
   75 IF (K-40) 77,76,76
   76 L=3
      GO TO 25
   77 K=K&1
      GO TO 74
   80 N=K
      XL=A&E(N-2)*R/E(N)
      XR=A&E(N-1)*R/E(N)
       YL = FUN1(XL,NF)
      IF(ITERM.NE.0) GO TO 160
       YR = FUN1(XR,NF)
      IF(ITERM.NE.0) GO TO 150
      J=1
   90 NJ=N-J
      NJONE=N-J-1
      NJTWO=N-J-2
      GO TO (100,101), JMIMAX
  100 IF (YR-YL) 130,130,110
  101 IF (YR-YL) 110,110,130
  110 IF (J-N&3) 120,160,160
  120 B=XR
      A=A
      R=B-A
      XR=XL
      XL=A&E(NJTWO)*R/E(NJ)
      YR=YL
       YL = FUN1(XL,NF)
      IF(ITERM.NE.0) GO TO 160
  125 J=J&1
      GO TO 90
  130 IF (J-N&3) 140,150,150
  140 B=B
      A=XL
      R=B-A
      XL=XR
      XR=A&E(NJONE)*R/E(NJ)
      YL=YR
       YR = FUN1(XR,NF)
      IF(ITERM.NE.0) GO TO 150
      GO TO 125
  150 XMIMAX=XR
      YMIMAX=YR
      GO TO 170
  160 XMIMAX=XL
      YMIMAX=YL
  170 RETURN
      END
```

```
CFIRE
      SUBROUTINE FIRE
        IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/BLKO/ H(40,40),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FO,E, P,TO,RS,SL, Z,Q,A,EL,
     2DELTA,FAC,C(40,10)
      COMMON/BLKI/M,N,L,LS,M1,MS,NS,IT,K,NC
      COMMON /END/ ITERM
C
C
C            SUBROUTINE FIRE, PART OF THE DAVIDON MINIMIZATION CALCULA-
C        TIONS, EVALUATES THE PENALTY FUNCTION AND ITS GRADIENT AT THE
C        INTERPOLATED POINT AND DETERMINES IF THE LOCAL MINIMUM HAS BEEN
C        SUFFICIENTLY WELL LOCATED.  IF SO, THE RATE OF CHANGE OF THE
C        GRADIENT IS EVALUATED BY INTERPOLATING FROM ITS VALUES AT THE
C        END POINTS OF THE INTERVAL BEING CONSIDERED AND ITS VALUE AT
C        THE INTERPOLATED POINT.
C
C
  400 M1=2
  401 CALL FCN(N,GB,FB,T,M1)
      IF(ITERM.EQ.0) GO TO 402
C
      DO 10 I = 1,N
10    X(I) = T(I)
      GO TO 412
C
  402 M=1
  403 CALL MATMP (M,N,S,GB,GSB)
      TP1=  DMIN1(F,FP)
  405 IF (TP1-FB&E)418,406,406
  406 TP1=A/(1.0-A)
  407 TP2=(1.0-A)/A
  408 TD=GSB*(TP1-TP2)
  409 IF(DABS(TD)-Q) 413,410,410
  410 GSS=2.0*Q
  411 L=1
C
  412 RETURN
C
  413 GSS=TD&2.0*Q
  414 DO 415 I=1,N
  415 G(I)=(GB(I)-G(I))*TP1&(GP(I)-GB(I))*TP2
C
  416 L=2
  417 GO TO 412
C
  418 IF (F-FP)419,428,428
  419 WRITE(6,1)
  420 EL=(1.0-A)*EL
  421 FP=FB
  422 GSP=GSB
  423 DO 425 I=1,N
  424 XP(I)=T(I)
  425 GP(I)=GB(I)
C
  426 L=3
  427 GO TO 412
C
```

```
428 WRITE(6,2)
429 FL=FL*A
430 F=FB
431 GS=GSB
432 DO 434 I=1,N
433 X(I)=T(I)
434 G(I)=GB(I)
435 GO TO 426
  1 FORMAT (10HCMOVE LEFT)
  2 FORMAT (11HCMOVE RIGHT)
    END
```

```
CFLOWE
      SUBROUTINE FLOWE (ENET,B1,IND)
      IMPLICIT REAL *8 (A-H,O-Z)
      COMMON /NINPUT/ AKW,RHOW,CRHOW,DELWH,     TABL,DHCHEM,RHUSL,
     1  RTG,BCON,ACON,     B21,B22,B23,     C(159)
      COMMON /TBLS12/ ERNTBL(8,10),ERNRTB(10),ERNUTB(8),
     1   ENTABL(25,9),RSTABL(9),HSTABL(25),
     2   ETABL(12,11),THTTBL(11),EMCTBL(12),
     3        D(11,5,6),XYZTBL(11,3)
      COMMON /FPLTNK/ BZ,RN,THETAC,DB,GAMMAE,COTA,COVA,PICIPU,PU,
     1   AMU,RHOU,UU,HU,AMUU,AMINFC,RHOIC,HINFC,UINFC,AMBLSD,
     2   AMABLD,Z,SC,ZBLT
      EQUIVALENCE (OCCUR(3563),CCON)
      DIMENSION OCCUR(4000)
      DIMENSION NOCCUP(30)
      COMMON OCCUR,NOCCUP
      EQUIVALENCE
     1   (RHO,RHOU),(V,UU)
C
C
C
C
C         SUBROUTINE FLOWE CALCULATES THE ELECTRON DENSITY TRANSITION,
C      N SUB ET  (E/CC), AND THE DECAY RATE, B1.
C
C
C
C
C        INPUT TABLES
C
C        ERNTBL  = EQUILIBRIUM NORMAL SHOCK ELECTRON DENSITY TABLE
C                  (TABLE F)
C        ERNRTB  = RHO, DENSITY ARGUMENT OF TABLE F (LBM/FT-3)
C        ERNUTB  = VELOCITY ARGUMENT OF TABLE F  (1000 FT/SEC)
C
C        ENTABL  = EQUILIBRIUM ELECTRON DENSITY TABLE   (TABLE B)
C        HSTABL  = H/RTO, ENTHALPY ARGUMENT OF TABLE B, NON-DIMENSIONAL
C        RSTABL  = RHO/RHOO-DENSITY ARGUMENT OF TABLE B, NON-DIMENSIONAL
C
C        ETABL   = TABLE OF MACH NUMBER (TABLE E)
C        EMCTBL  = MC, CONE MACH NUMBER-ARGUMENT OF TABLE E
C        THTTBL  = THETAC, CONE HALF ANGLE-ARGUMENT OF TABLE E, DEGREES
C
C        D       = ELECTRON DENSITY AS A FUNCTION OF NORMALIZED ENTHALPY
C                  AND AIR DENSITY FOR 1000 PPM SODIUM SEED (TABLE D)
C        XDTABL  = RHO/RHOO, AIR DENSITY ARGUMENT OF TABLE D, NON-
C                  DIMENSIONAL
C        YDTABL  = H/RTO, ENTHALPY ARGUMENT OF TABLE D, NON-DIMENSIONAL
C        ZDTABL  = MRAT, THE RATIO OF ABLATED MASS LOSS RATE TO THE MASS
C                  LOSS RATE IN THE BOUNDARY LAYER, ARGUMENT OF TABLE D
C
C
C
C
C          THE FOLLOWING ARE INPUT QUANTITIES.
C
C        AKW = HEATSHIELD CONDUCTIVITY,(BTU/FT-HR-DEG. R)
C        AMABLD = MASS ABLATED (LBM/ SEC)
C        AMBLSD = MASS SWALLOWED BY BOUNDARY LAYER (LBM/SEC)
C        AMINFC = CONE MACH NUMBER
C        AMU = UPSTREAM MACH NUMBER
```

```
C          AMUU = FREE STREAM VISCOSITY (LBM/FT-SEC)
C          B7 = SCALE HEIGHT (1,000 FT)
C          B21 = SCALING CONSTANT
C          B22 = SCALING CONSTANT
C          B23 = SCALING CONSTANT
C          CDTA = TOTAL DRAG*AREA (FT-SQ)
C          CDVA = VISCOUS DRAG*AREA (FT-SQ)
C          CRHOW = HEATSHIELD SPECIFIC HEAT,(BTU/LB-DEG. R)
C          C(59) = PRESET CONSTANT
C          C(60) = PRESET CONSTANT
C          C(67) =  PRESET CONSTANT
C          C(69) =  PRESET CONSTANT
C          C(83-93) = PRESET CONSTANTS
C          C(100) = PRESET CONSTANT
C          C(115-125) = PRESET CONSTANTS
C          C(130-136) = PRESET CONSTANTS
C          C(159) = PRESET CONSTANT
C          C(160) = PRESET CONSTANT
C          C(164) = PRESET CONSTANT
C          C(165) = PRESET CONSTANT
C          C(169) = PRESET CONSTANT
C          DB = BASE DIAMETER,(FT)
C          DELWH = HEATSHIELD THICKNESS,(IN)
C          DHCHEM = CHEMICAL ENTHALPY OF HEATSHIELD (FT-SQ / SEC-SQ)
C          GAMMAE = ENTRY ANGLE (RAD)
C          HINFC = CONE ENTHALPY (FT-SQ / SEC-SQ)
C          HU = UPSTREAM STATIC ENTHALPY (FT-SQ/SEC-SQ)
C          PICIPU = RATIO OF CONE TO UPSTREAM PRESSURE
C          PU = UPSTREAM PRESSURE (LB/FT-SQ)
C          RHOIC = CONE DENSITY (LBM/ FT-3)
C          RHOSL = SEA LEVEL DENSITY (LBM/FT-3)
C          RHOU  = UPSTREAM DENSITY,(LBM/FT-3)
C          RHOW = HEATSHIELD DENSITY,(LBM/FT-3)
C          RN = NOSE RADIUS (FT)
C          RTO = REFERENCE ENTHALPY (FT-SQ/SEC-SQ)
C          SC = LENGTH OF CONICAL FRUSTUM (FT)
C          TABL = ABLATION TEMPERATURE OF HEATSHIELD (DEG. K)
C          THETAC = CONE ANGLE (RAD)
C          UINFC = CONE VELOCITY (1000 FT/SEC)
C          UU  = UPSTREAM VELOCITY,(1000 FT/SEC)
C          Z = ALTITUDE (1,000 FT)
C          ZBLT = BOUNDARY LAYER TRANSITION ALTITUDE (1,000 FT)
C
C
      PI = 3.141592654
C
C
C          AKV = HEATING CONSTANT
C          REUD = REYNOLDS NUMBER UPSTREAM
C
      REUD = 1.D3*RHOU *UU *DB /AMUU
      AKV = AKW*UU *DSIN(GAMMAE) /(RHOW*CRHOW*DELWH**2.D0)
      ZKEEP = Z
      IF (Z.GE.ZBLT) GO TO 1
      Z = ZBLT
      GO TO 1
C
C
C          TWC = TEMPERATURE WALL CONE (DEG. K)
C
```

```
    3 Z = ZKEEP
      TWC = C(160)*(AKV*(ZBLT-Z ))**C(159)/((SC*DEXP(Z/BZ)/DSIN(THETAC)*
     1*2)**.5D0*(AKW/(DELWH*UU **3.D0)))&TWC
      GO TO 2
    1 TWC = 278.D0& C(60)*(AKV*Z )**C(59) / ((SC*DEXP(Z/BZ)/DSIN(THETAC)*
     1*2)**.5D0*(AKW/(DELWH*UU **3.D0)))
      IF (ZKEEP.LT.ZBLT)  GO TO 3
C
C
C        AMBLDS = MASS SWALLOWED BY BOUNDARY LAYER (LBM/ SEC)
C        TW = TEMPERATURE WALL (DEG. K)
C        TWSP = TEMPERATURE WALL SPHERE (DEG. K)
C
    2 TWSP = 278.D0 &C(60)*(AKV*Z )**C(59) / (AKW*DB**.5D0*DEXP(Z /(4.D0
     1   *BZ)) / (UU **1.5D0*DELWH))
      AMBLDS = AMBLSD & AMABLD
      IF ((TABL.LE.TWC.AND.2.D0*RN.LT.0.9999*DB).OR. (TABL.LE.TWSP
     1   .AND.2.D0*RN.GE.0.99D0*DB))   TW=TABL
      IF ( 2.D0*RN.LT.0.99D0*DB.AND.TWC.LT.TABL)   TW=TWC
      IF ( 2.D0*RN.GE.0.99D0*DB.AND.TWSP.LT.TABL)   TW=TWSP
C
C
C        CDSS2A= DRAG*AREA 2ND ENTROPY LAYER (FT-SQ)
C        HW= ENTHALPY AT THE WALL (FT-SQ/ SEC-SQ)
C
       HW = 1.087D4*TW
      CDSS2A = CDTA-CDVA
      IF ( IND.NE.1)  GO TO 203
      WRITE (6,103) REUD,AKV,TWC,TWSP,AMBLDS,TW,HW,CDSS2A
  103 FORMAT (//9X,4HREUD,12X,3HAKV,11X,3HTWC,10X,4HTWSP,9X,6HAMBLDS,
     1   10X,2HTW,14X,2HHW,7X,6HCDSS2A/2X,3D14.5)
C
C
C        AMRAT = RATIO ABLATION TO BOUNDARY LAYER AIR
C        THETSI = SHOCKANGLE UNIVERSAL (RAD)
C
  203 CONTINUE
      AMRAT = AMABLD/AMBLDS
      IF (PICIPU  .GT.(19.DC/6.D0))  GO TO 7
      THETSI =          DARSIN(1.D0/AMU )
      GO TO 8
    7 THETSI =          DARSIN(1.D0/AMU *(6.D0/7.D0*(PICIPU  )-13.D0/7.D0)
     1   **.5D0)
    8 THETSI = DMAX1(THETSI,THETAC)
C
C
C        AMSS2D = MASS FLOW 2ND ENTROPY LAYER (LBM/ SEC)
C        B35 = NSRN FACTOR
C        THETS2 = SHOCKANGLE MAX (RAD)
C        THTS2B = AVERAGE SHOCK ANGLE FOR SECOND ENTROPY LAYER (RAD)
C        U2C = VELOCITY CONE-2ND ENTROPY LAYER (KFT / SEC)
C
      AMSS2D = 2.D3*RHOU *RN**2.D0*DCOTAN(THETSI)**2*UU
      U2C = UU -5.D2*RHOU *UU **2.D0*CDSS2A/AMSS2D
      U2C = DMAX1(U2C,1.D0)
      AI=.286D0&1.C290D*AMU **2.D0*(1.D0-(U2C/UU )**2.D0)
      THETS2 = DARSIN(1.D0/AMU *((AI&(2.86D0&AI)**.5D0)/2.D0)**.5D0)
      THETS2 = DMAX1(THETS2,THETAC)
      THTS2B = .5D0*(THETS2&THETSI)
      B35  = C(119)*UU **C(120)
```

```
      IF ( IND.NE.1)  GO TO 204
      WRITE (6,104) AMRAT, THETS1,AMSS2D,U2C,A1,THETS2,THTS2D,B35
  104 FORMAT (/7X,5HAMRAT,10X,6HTHETS1,8X,6HAMSS2D,9X,3HU2C,11X,2HA1,
     1   8X,6HTHETS2,10X,6HTHTS2D,8X,3HB35/2X,8D14.5)
C
C
C        AMNDS = MASS FLOW NOSE (LBM/ SEC)
C        SRAT = RATIO BOUNDARY SWALLOWING TO NOSE MASS FLOW
C
  204 CONTINUE
      AMNDS = 3.141592654*RN**2.D0*C(116)*RHOU *UU
      IF (AMBLSD.GE.AMNDS) GO TO 9
      SRAT= AMBLSD/AMNDS
      GO TO 10
    9 SRAT= 1.D0
C
C
C        ENERN = ELECTRON DENSITY AT NOSE CAP (E/CC)
C        ENRN = NO. OF ELETRONS PRODUCED BY NOSE CAP (E/ SEC)
C        H2C = ENTHALPY CONE-2ND ENTROPY LAYER(FT-SQ/ SEC-SQ)
C        P2C = PRESSURE CONE-2ND ENTROPY LAYER (LB/FT-SQ)
C        RHO2C = DENSITY CONE-2ND ENTROPY LAYER (LBM/FT-3)
C
   10 CALL AR2DIM (10, B,RHO,ERNRTB,V,ERNUTB,ENERN,ERNTBL)
      ENRN =  30.48D0**3.D0*AMNDS*SRAT*ENERN/RHCU
      P2C = (7.D0*AMU **2.D0*DSIN(THTS2B) **2.D0-1.D0) *PU /6.D0
      H2C  =  HU *P2C*(P2C&6.D0*PU )/(PU *(6.D0*P2C&PU ))
      RHO2C = RHOU *(6.D0*P2C&PU )/(P2C&6.D0*PU)
      IF (AMBLSD.GE.AMSS2D) GO TO 11
C
C
C        HC = ENTHALPY CONE (FT-SQ / SEC-SQ)
C        PC = PRESSURE CONE (LB/FT-SQ)
C        RHOC =  DENSITY CONE (LBM/FT-3)
C        SCHEM = CHEMICAL LENGTH
C        UC = VELOCITY CONE (KFT / SEC)
C
      RHOC = RHO2C
       HC =  H2C
      PC = P2C
      UC = U2C
      SCHEM=RHO2C**C(117)* SC*AMBLSD/(U2C*AMSS2D)
      GO TO 12
   11 RHOC = RHOIC
       HC =  HINFC
      PC = PICIPU*PU
      UC = UINFC
      SCHEM = RHO2C**C(117)*SC*AMSS2D /(U2C*AMBLSD)   &
     1   RHOIC**C(117)*SC*(AMBLSD-AMSS2D) /(UINFC*AMBLSD)
C
C
C        FNSRN = NO. OF ELECTRONS NOSE CAP -EXP AT SHOULDER (E/ SEC)
C
   12 FNSRN = C(122)*ENRN*AMNDS*(1.D0-C(121) & (1.D0&ENRN*SCHEM)
     1   *C(121)*DEXP(-B35  * SCHEM)) /(AMNDS&C(123)*SCHEM*ENRN
     2   *TN**C(124))
      IF ( IND.NE.1)  GO TO 205
      WRITE (6,105) AMNDS, SRAT,ENERN,ENRN,P2C,U2C,RHO2C,RHOC
  105 FORMAT (/8X,5HAMNDS,11X,4HSRAT,9X,5HENERN,9X,4HENRN,11X,3HP2C,
     1   10X,3HU2C,11X,5HRHO2C,8X,4HRHOC/2X,8D14.5)
```

```
  205 CONTINUE
C
C
C        ENEQH = EQUILIBRIUM ELECTRON DENSITY (E/CC)
C
      RHOC12 = RHOC / RHOSL
      HCRTO = HC/RTO
      IF (AMRAT.EQ.0.D0)  GO TO 13
      ENEQH = AR3DIM(D,11, 5, 4,RHOC12,HCRTO,AMRAT,XYZTBL)
      GO TO 14
   13 CALL AR2DIM ( 9,25,RHOC12,RSTABL,HCRTO,HSTABL,ENEQH,ENTABL)
   14 CONTINUE
C
C
C        ENBL = NO. OF ELECTRONS LEAVING BOUNDARY LAYER (E/SEC)
C        ENEBL = ELECTRON DENSITY IN THE BOUNDARY LAYER (E/CC)
C
      ENEBL = ENEQH*(1.D0-DEXP(-B22*SCHEM**C(118)))*
     1   (B21 & B23 * (UC-22.D0)/22.D0)
      ENBL =   30.48D0**3.D0*ENEBL*AMBLDS/PC
      IF (IND.NE.1)  GO TO 206
      WRITE (6,106) HC,PC,UC,SCHEM,ENSRN,ENEQH,ENEBL,ENBL
  106 FORMAT(/11X,2HHC,12X,2HPC,12X,2HUC,13X,5HSCHEM,8X,5HENSRN,10X,
     1     5HENEQH,10X,5HENEBL,8X,4HENBL/2X,8D14.5)
  206 CONTINUE
C
C
C        AM2 = MACH NUMBER 2ND ENTROPY LAYER
C        AM2C = MACH NUMBER CONE-2ND ENTROPY LAYER
C        AMINF = FREE STREAM MACH NUMBER
C        ENS = NO. OF ELECTRONS ENTERING WAKE NECK (E / SEC)
C        H2 = ENTHALPY 2ND ENTROPY LAYER (FT-SQ / SEC-SQ)
C        RHO2 = DENSITY 2ND ENTROPY LAYER (LBM/FT-3)
C        U2 = VELOCITY OF SECOND ENTROPY LAYER (1000 FT/SEC)
C
      ENS = ENBL & ENSRN
      AM2C = U2C*AMU /UU *(HL/H2C)**.5D0
      AM2C = DMAX1(AM2C,1.D0)
      THETCD = THETAC*57.2957795100
      CALL AR2DIM (11,12,THETCD,THTTBL,AM2C,EMCTBL,AM2,ETABL)
      CALL AR2DIM (11,12,THETCD,THTTBL,AMINFC,EMCTBL,AMINF,ETABL)
      RHOINF = RHOIC*(((1.D0&.2D0*AMINFC**2.D0)/(1.D0&.2D0*AMINF**2.D0))
     1   **2.5D0
      HINF = HINFC*((1.D0&.2D0*AMINFC**2.D0) / (1.D0&.2D0*AMINF**2.D0))
      UINF = UINFC*AMINF /AMINFC*(HINF/HINFC)**.5D0
      RHO2 = RHO2C*((1.D0&.2D0*AM2C**2.D0) / (1.D0&.2D0*AM2**2.D0))
     1   **2.5D0
      H2 = H2C*((1.D0&.2D0*AM2C**2.D0) / (1.D0&.2D0*AM2**2.D0))
      U2 = U2C*AM2/AM2C*(H2/H2C)**.5D0
      IF (AMBLSD.GE.AMSS2D)  GO TO 21
C
C
C        AMS = MACH NUMBER SHOULDER
C        HS = ENTHALPY SHOULDER (FT-SQ / SEC-SQ)
C        RES = REYNOLDS NUMBER SHOULDER
C        RHOS = DENSITY SHOULDER (LBM/FT-3)
C        US = VELOCITY SHOULDER (KFT / SEC)
C
      AMS = AM2
      RHOS = RHO2
```

```
      HS = H2
      US = U2
      GO TO 22
   21 AMS = AMINF
      RHOS = RHOINF
      HS = HINF
      US = UINF
   22 RES = RHOS*AMS*RCUD*C(169)/(RHOL *AMU )*(HS/HU )**C(67)
      IF ( IND.NE.1)  GO TO 207
      WRITE (6,107) ENS,AM2C,AM2,RHO2,H2,U2,AMS,RHOS
  107 FORMAT (/10X,3HENS,11X,4HAM2C,10X,3HAM2,10X,4HRHO2,11X,2HH2,11X,
     1    2HU2,13X,3HAMS,9X,4HRHOS/2X,8D14.5)
  207 CONTINUE
C
C
C         ENEN = ELECTRON DENSITY AT THE NECK (E/CC)
C         HN = ENTHALPY NECK (FT-SQ / SEC-SQ)
C         HNIHS = RATIO NECK ENTHALPY TO SHOULDER ENTHALPY
C
      CS = C(164)&C(165)*DSIN(THETAC)**.25D0*RES**(-3.D0/8.D0)
     1    *AMS**(-.5D0)
      HN = HW& CS*(HS-HW&.5D6*US**2.D0)-DHCHEM
      HNIHS = 2.D0*HN/(2.D0*HS&1.D6*US**2.D0)
      ENEN = RHOS*ENS*HS/(30.48D0**3.D0*AMBLDS*HN)
      IF ( IND.NE.1)  GO TO 208
      WRITE (6,108) HS,US,RES,HN,HNIHS,RHOS,ENS,ENEN
  108 FORMAT(/10X,2HHS,13X,2HUS,11X,3HRES,11X,2HHN,10X,5HHNIHS,10X,
     1    4HRHOS,12X,3HENS,9X,4HENEN/2X,8D14.5)
  208 CONTINUE
C
C
C         RETS = SHOULDER REYNOLDS NUMBER BASED ON THETA
C         THETSS = SHOULDER WAKE MOMENTUM THICKNESS (FT)
C         THTBLS = INITIAL WAKE MOMENTUM THICKNESS BASED ON SHOULDER
C         CONDITIONS (FT)
C
      THTBLS = (CDTA*RHOU /(2.D0*PI*RHOS))**.5D0*(UU /US)
      IF (AMBLSD.GE.AMSS2D) GO TO 23
      THETSS =  (RHOU /(2.D0*PI*RHOS)*(CDVA& AMSS2D*CDSS2A/AMBLSD))
     1    **.5D0*(UU /US)
      GO TO 24
   23 THETSS = THTBLS
   24 RETS = THETSS*RES/DB
      IF (Z.GT.ZBLT)  GO TO 25
C
C
C         AKE = GTCHEM FACTOR
C         B1 = DECAY RATE
C         B5 =  NET SCALING FACTOR
C         B11 = ELECTRON DECAY RATE FACTOR
C         GT = FUNCTION AERO
C
      GT = 0.D0
      GO TO 26
   25 GT = (1.D0-HN*(1.D0-HN/HS) /(2.D6*C(90)*RHOS*THETSS*US**2.D0
     1    *RETS*(1.D0&HNIHS)))**(-1.D0)
   26 B5 = C(83)*(1.D0& C(84)*AMPAT**C(85)&C(86)*AMPAT**C(87)
     1    &C(88)*(RHOS/RHOSL)**C(89))
      B11 = C(91)&C(92)*AMPAT**C(93)
      B1 =(AMUU *(C(115)&B11*(RHOS/RHOSL)**C(125))/(1.D6*US**2.D0*THTBLS
```

```
     1     ))*CCON**BCON
      AKE = (THETSS)**(-2.D0)-7.5D28*RHOS*C(100)/ENEN
      IF (IND.NE.1)  GO TO 209
      WRITE (6,109) THTBLS,THETSS,RETS,GT,B5,B11,B1,AKE
  109 FORMAT(/7X,6HTHTBLS,10X,6HTHETSS,9X,4HRETS,10X,2HGT,12X,2HB5,
     1     11X,3HB11,14X,2HB1,10X,3HAKE/2X,8D14.5)
  209 CONTINUE
      IF (Z.GT.ZBLT)  GO TO 27
C
C
C         ENET = TRANSITION ELECTRON DENSITY (E/CC)
C         GTCHEM = FUNCTION CHEMICAL
C
      GTCHEM = 1.D0
      GO TO 28
   27 GTCHEM = (1.D0&HN/(4.D0*C(90)*US*AKE*RHOS*THETSS*RETS))**(-1.D0)
   28 ENET =(1.D-3**C(134)*AMUU *B5*RHOS**C(133)*GT/(THETSS*US**C(134))
     1     *(1.D0 -DEXP(-DABS(HN)* (C(135) &C(136)*DABS(HN)**C(130)
     2     &C(131)*DABS(HN)**C(132))))  &  1.11D27*RHOS*C(100)
     3     &ENEN*GTCHEM)*CCON**ACON
      IF (IND.NE.1)  GO TO 210
      WRITE (6,110) GTCHEM,ENET
  110 FORMAT (/7X,6HGTCHEM,11X,4HENET/2X,2D14.5//)
C
C
  210 CONTINUE
  113 CONTINUE
      RETURN
      END
```

```
CFMIMAX
      IMPLICIT  REAL*8 (A-H, O-Z)
      FUNCTION FMIMAX(X,NF)
      COMMON/MINSK/N,K,ALB(20),UB(20),XX(20),FI
      COMMON/IOPT/IPROC,IN,NCONS,IPNT,IFX,LIMIT,IRAND
      COMMON/FOPT/ERR,PRAND, FAC, DELTA
C
C
C          IN THE FIBONACCI OPTIMIZATION TECHNIQUE, FUNCTION FMIMAX
C        IS SET EQUAL IN TURN TO EACH OF THE N UNIMODAL FUNCTIONS OF
C        ONE VARIABLE BEING MINIMIZED (MAXIMIZED) IN ACCORDANCE WITH
C        THE VALUE OF NF.
C
C
       GO TO (1,1,3), NF
 1    CALL FFV(1,X, VAL)
      FMIMAX  = VAL
      GO TO 1000
 3    XX(1) = X
      CALL FFV(2,XX,VAL)
      FMIMAX = VAL
 1000 RETURN
      END
```

```
CFUN1
      FUNCTION FUN1(XX,N)
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON /CSIG/ XTT,WS1,XODP,DWST,SPH2,XLMS,XMSP,XSSP,B1,ZCR2,ZCR4,
     1XB20,DWBST1,SPH4,BC,DDW,WS4,SIGMDS,IND2
C
C
C           FUNCTION FUN1 COMPUTES THE PULSE SHAPE RADAR RETURN AS A
C        FUNCTION OF DISTANCE BEHIND THE LEADING EDGE OF THE RADAR
C        PULSE.
C
C
      SIG1= 0.0D0
      SIG2= 0.0D0
      SIG3= 0.0D0
      SIG4= 0.0D0
      XXTT= XX -  XTT
C
C         Y1 -  REGION AFFECTED BY OVERDENSE SCATTERING
  701 Y1 = DMIN1(WS1,XODP)
      Y1 = DMIN1(Y1,XXTT)
      WS2 = XTT & XODP & WS1 - XX
      Y1 = DMIN1(Y1,WS2)
      IF(XXTT)702,703,703
  703 IF(XXTT-WS1-XODP)704,704,702
C
C         SIG1 - PORTION OF PULSE SHAPE DUE TO OVERDENSE RETURN
  704 SIG1 = Y1 * DWST * SPH2
  702 WS2 = 2.0D0 * XLMS
C
C         Y2 - REGION AFFECTED BY FIRST PART OF MULTIPLE SCATTERING
       Y2 = DMIN1(WS1,WS2)
      WS2 = XXTT - XODP
       Y2 = DMIN1(WS2,Y2)
      WS2 = XTT & XMSP & WS1 -XX
       Y2 = DMIN1(Y2,WS2)
      IF(XXTT - XODP)705,706,706
  706 IF(XXTT - WS1 - XMSP)707,707,705
C         SIG2 - PORTION OF PULSE SHAPE DUE TO CONSTANT PORTION OF
C
C                    MULTIPLE SCATTERING REGION
  707 SIG2 = 0.5D0 * Y2 * DWST * SPH2
  705 WS3 = 0.5D0 * WS1
      IF(WS1 - (XX - XTT - XMSP))708,709,709
C
C         Y31 - UPPER LIMIT OF REGION AFFECTED BY SECOND PART OF
C                  MULTIPLE SCATTERING
  708  Y31 = XX - WS1 - XTT
      GO TO 710
  709  Y31 = XMSP
  710 IF(XX-(XTT & XSSP))711,711,712
C
C         Y32 - LOWER LIMIT OF REGION AFFECTED BY SECOND PART OF
C                  MULTIPLE SCATTERING
  711   Y32 = XXTT
      GO TO 713
  712  Y32 = XSSP
  713 IF(WS1 - (XXTT - XSSP))714,715,715
C
```

```
C          Y41 - UPPER LIMIT OF REGION AFFECTED BY SINGLE SCATTERING
  715  Y41 = XSSP
       GO TO 716
  714  Y41 = XXTT-WS2
C
C          Y42 - LOWER LIMIT OF REGION AFFECTED BY SINGLE SCATTERING
  716   Y42 = XXTT
       IF(XXTT - XMSP)720,721,721
  721 IF(XXTT - (WS1 & XSSP))717,717,720
  717 EX1 =(DEXP(-B1* Y31) -DEXP(-B1* Y32))* ZCR2/16.0D0
       EX2 =(DEXP(-4.0D0* B1* Y31) - DEXP(-4.0D0*B1 * Y32))
C
C          THE FOLLOWING TEST IS USED TO PREVENT UNDERFLOW
       IF(DABS(EX2) - 1.0D-6)9007,9007,9008
 9007 EX2 = 0.0D0
 9008 EX2 = 0.25D0 * ZCR4 * EX2 * ZCR4
       IF(XB20)719,719,718
C
C          SIG3 - PORTION OF PULSE SHAPE DUE TO VARIABLE PORTION OF
C                    MULTIPLE SCATTERING REGION
  719  SIG3 = DWBSTI * (EX1 & EX2) & (Y32 - Y31) * SPH4 * B0 * DDW
       GO TO 720
  718  SIG3 = DWBSTI * (EX1 & EX2) & 2.0D0 * WS4 *(DEXP(-0.5D0 * B1 *
     1          XB20*Y31)- DEXP(-0.5D0* B1* XB20*Y32))* B0 * SPH2**(2.0D0-
     1 XB20)/(B1*XB20) *DWST
  720  IF(XXTT - XSSP)730,722,722
  722  EX1 = DEXP(-4.0D0* B1* Y41)- DEXP(-4.0D0* B1* Y42)
       EX2 = DEXP(-B1* Y41) - DEXP(-B1* Y42)
C
C          SIG4 - PORTION OF RETURN DUE TO SINGLE SCATTERING REGION
       SIG4 = 0.25D0*DWBSTI* ZCR4*EX1*ZCR4 & DDW/B1 *(SPH2/16.0D0
     1   *DWST/DDW & B0) *ZCR2 * EX2
C
C          SIG - PULSE SHAPE - RADAR RETURN AS A FUNCTION OF DISTANCE
C                    BEHIND THE LEADING EDGE OF THE RADAR PULSE
  730  SIG = SIG1 & SIG2 & SIG3 & SIG4
       IF(IND2-1)30005,10005,30005
10005 WRITE (6,20005) Y1,SIG1,Y2,SIG2,Y31
20005 FORMAT(10X,7H     Y1=,1PE15.7,6H  SIG1=,1PE15.7,6H    Y2=,1PE15.7,10H
     1      SIG2=,1PE15.7,6H  Y31=,1PE15.7)
10006 WRITE (6,20006) Y32,Y41,Y42,SIG3,SIG4
20006 FORMAT(10X,7H    Y32=,1PE15.7,6H   Y41=,1PE15.7,6H   Y42=,1PE15.7,10H
     1      SIG3=,1PE15.7,6H SIG4=,1PE15.7)
10010 WRITE (6,20010) XX,SIG
20010 FORMAT(2X,2HX=,1PE15.7,6H   SIG=,1PE15.7)
30005  GO TO (100,101),N
C
  100    FUN1 = SIG
C
       RETURN
C
  101  FUN1 = (SIGMDS - SIG)**2
C
       RETURN
       END
```

```
CF123
      SUBROUTINE F123(XXX)
        IMPLICIT REAL*8 (A-H,O-Z)
C
C
C         SUBROUTINE F123 CAN OPTIONALLY  -  (1) READ DATA FOR A
C      REENTRY VEHICLE TRAJECTORY FROM INPUT OR CALL SUBROUTINE VIXEN
C      TO CALCULATE THIS DATA.  (2) CALL VIXEN TO CALCULATE THE DATA
C      FOR A DECOY TRAJECTORY.  (3) COMPARE THE DATA FOR A REENTRY
C      VEHICLE TRAJECTORY WITH THE DATA FOR A DECOY TRAJECTORY AND
C      SAVE THE DIFFERENCES.  (4) CALL INTGRL TO CALCULATE AND PLOT
C      A CORRIDOR INTEGRAL.  (5) CALL INTGRL TO CALCULATE THE SIGMA
C      SQUARE INTEGRAL TO BE USED BY SUBROUTINE EFFECT.  (6) CALL
C      INTGRL TO CALCULATE A TABLE OF INFLUENCE COEFFICIENTS AND TO
C      PRODUCE INFLUENCE COEFFICIENT PLOTS AT SPECIFIED ALTITUDES.
C
C
      COMMON OCCUR,NOCCUR
      COMMON /CICCUR/ IOCCUR(320)
      COMMON /CPCCUR/ PCCUR(11770)
       COMMON /TTMCOM/ TTM
      COMMON /INFTST/ NDDCOY
       REAL * 8 LA1, LA2, MDOT, MW, MX, MY, MZ
      DIMENSION ALMAX(200),ALMIN(200),BCB(40),BCD(40),BCV(40),BCWL1(40)
      DIMENSION BCWL2(40),BCWL3(40),BCWR1(40),BCWR2(40),BCWR3(40)
       DIMENSION  TBMAT(3), TT(200)
      DIMENSION BETAPL(160),BS(160),COFINF(2,2,2),DB(160),DD(160)
      DIMENSION DS(160),DV(160),DVAR(50),DVH(50),DVL(50),DWL1(160)
      DIMENSION DWL2(160),DWL3(160),DWR1(160),DWR2(160),DWR3(160)
      DIMENSION FMAX(200),FMIN(200),H(4),HOLD(3,50),ICP(90),MDOT(4,8)
      DIMENSION NCOMDV(50),NOCCUR(30),NPV(160),OCCUR(4000),PEPSB(6)
      DIMENSION ODOT(4,8),SAVE(9,160,3),SB(40),SD(40),SV(40),SWL1(40)
      DIMENSION SWL2(40),SWL3(40),SWR1(40),SWR2(40),SWR3(40),TAMAX(200)
      DIMENSION TAMIN(200),TCB(40),TCD(40),TCV(40),TCWL1(40),TCWL2(40)
      DIMENSION TCWL3(40),TCWR1(40),TCWR2(40),TCWR3(40),TM(140)
      DIMENSION TPLOT(160),TS(160),TTM(200),VPLOT(160),VS(160)
      DIMENSION VDOPLT(160),WL1P(160),WL1S(160),WL2P(160),WL2S(160)
      DIMENSION WL3P(160),WL3S(160),WR1P(160),WR1S(160),WR2P(160)
      DIMENSION WR2S(160),WR3P(160),WR3S(160),ZMAX(200),ZMIN(200)
      DIMENSION ZPLOT(160),ZS(160)
      EQUIVALENCE (OCCUR(00229), ALALT )
      EQUIVALENCE (OCCUR(01044), ALMAX )
      EQUIVALENCE (OCCUR(01244), ALMIN )
      EQUIVALENCE (OCCUR(00002), ALPHA )
      EQUIVALENCE (OCCUR(00003), ALPRIM)
      EQUIVALENCE (OCCUR(00122), ALST  )
      EQUIVALENCE (OCCUR(00128), CASE  )
      EQUIVALENCE (OCCUR(00099), CDB   )
      EQUIVALENCE (OCCUR(02793), COFINF)
      EQUIVALENCE (OCCUR(00100), CDI   )
      EQUIVALENCE (OCCUR(00098), CDP   )
      EQUIVALENCE (OCCUR(00101), CDPO  )
      EQUIVALENCE (OCCUR(00202), CM    )
      EQUIVALENCE (OCCUR(00203), CN    )
      EQUIVALENCE (OCCUR(00094), CODLAM)
      EQUIVALENCE (OCCUR(00216), CPSZET)
      EQUIVALENCE (OCCUR(00215), CTHZET)
      EQUIVALENCE (OCCUR(00127), DATE  )
      EQUIVALENCE (OCCUR(00235), DECDEP)
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NOT REPRODUCIBLE

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      EQUIVALENCE (OCCUR(00236), DECRTC)
      EQUIVALENCE (OCCUR(00234), DFLCOP)
      EQUIVALENCE (OCCUR(00219), DELY  )
      EQUIVALENCE (OCCUR(00220), DELZ  )
      EQUIVALENCE (OCCUR(00129), EMO   )
      EQUIVALENCE (OCCUR(00197), FACTR9)
      EQUIVALENCE (OCCUR(02244), FMAX  )
      EQUIVALENCE (OCCUR(02444), FMIN  )
      EQUIVALENCE (OCCUR(00105), GAMF0 )
      EQUIVALENCE (OCCUR(00028), GAMMA )
      EQUIVALENCE (OCCUR(00139), LA1   )
      EQUIVALENCE (OCCUR(00144), LA2   )
      EQUIVALENCE (OCCUR(02769), MDOT  )
      EQUIVALENCE (OCCUR(00117), MW    )
      EQUIVALENCE (OCCUR(00210), MX    )
      EQUIVALENCE (OCCUR(00211), MY    )
      EQUIVALENCE (OCCUR(00212), MZ    )
      EQUIVALENCE(OCCUR(4000),LP)
      EQUIVALENCE (OCCUR(02801), PEPS8 )
      EQUIVALENCE (OCCUR(00112), PHIO  )
      EQUIVALENCE (OCCUR(00223), PSIZET)
      EQUIVALENCE (OCCUR(00114), PSIG  )
      EQUIVALENCE (OCCUR(02676), QDOT  )
      EQUIVALENCE (OCCUR(00110), QG    )
      EQUIVALENCE (OCCUR(00060), RBDOT )
      EQUIVALENCE (OCCUR(00136), RB1   )
      EQUIVALENCE (OCCUR(00142), RB2   )
      EQUIVALENCE (OCCUR(00059), RNDOT )
      EQUIVALENCE (OCCUR(00135), RN1   )
      EQUIVALENCE (OCCUR(00141), RN2   )
      EQUIVALENCE (OCCUR(00116), SIG   )
      EQUIVALENCE (OCCUR(00221), SINGO )
      EQUIVALENCE (OCCUR(00111), SMRO  )
      EQUIVALENCE (OCCUR(00218), SPSZET)
      EQUIVALENCE (OCCUR(00217), STHZET)
      EQUIVALENCE (OCCUR(01444), TAMAX )
      EQUIVALENCE (OCCUR(01644), TAMIN )
      EQUIVALENCE (OCCUR(03643), TBMAT )
      EQUIVALENCE (OCCUR(00201), TH    )
      EQUIVALENCE (OCCUR(00113), THEALO)
      EQUIVALENCE (OCCUR(00224), THEZET)
      EQUIVALENCE (OCCUR(00246), TZTEST)
      EQUIVALENCE (OCCUR(00086), WDOT  )
      EQUIVALENCE (OCCUR(01844), ZMAX  )
      EQUIVALENCE (OCCUR(02044), ZMIN  )
      EQUIVALENCE (PCCUR(06181), BCB   )
      EQUIVALENCE (PCCUR(06101), BCD   )
      EQUIVALENCE (PCCUR(06021), BCV   )
      EQUIVALENCE (PCCUR(06501), BCWL1 )
      EQUIVALENCE (PCCUR(06581), BCWL2 )
      EQUIVALENCE (PCCUR(06661), BCWL3 )
      EQUIVALENCE (PCCUR(06261), BCWR1 )
      EQUIVALENCE (PCCUR(06341), BCWR2 )
      EQUIVALENCE (PCCUR(06421), BCWR3)
      EQUIVALENCE (PCCUR(00641), BETAPL)
      EQUIVALENCE (PCCUR(03841), BS    )
      EQUIVALENCE (PCCUR(02081), DB    )
      EQUIVALENCE (PCCUR(01921), DD    )
      EQUIVALENCE (PCCUR(03681), DS    )
      EQUIVALENCE (PCCUR(01761), DV    )
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      EQUIVALENCE (PCCUR(11707), DVAP  )
      EQUIVALENCE (PCCUR(11607), DVH   )
      EQUIVALENCE (PCCUR(11657), DVL   )
      EQUIVALENCE (PCCUR(02721), DWL1  )
      EQUIVALENCE (PCCUR(02881), DWL2  )
      EQUIVALENCE (PCCUR(03041), DWL3  )
      EQUIVALENCE (PCCUR(02241), DWR1  )
      EQUIVALENCE (PCCUR(02401), DWR2  )
      EQUIVALENCE (PCCUR(02561), DWR3  )
      EQUIVALENCE (PCCUR(05841), H     )
      EQUIVALENCE (PCCUR(07101), HOLD  )
      EQUIVALENCE (PCCUR(07251), SAVE  )
      EQUIVALENCE (PCCUR(06821), [illegible] )
      EQUIVALENCE (PCCUR(06781), SD    )
      EQUIVALENCE (PCCUR(06741), SV    )
      EQUIVALENCE (PCCUR(06591), SWL1  )
      EQUIVALENCE (PCCUR(07621), SWL2  )
      EQUIVALENCE (PCCUR(07661), SWL3  )
      EQUIVALENCE (PCCUR(06861), SWR1  )
      EQUIVALENCE (PCCUR(06901), SWR2  )
      EQUIVALENCE (PCCUR(06941), SWR3  )
      EQUIVALENCE (PCCUR(06221), TCB   )
      EQUIVALENCE (PCCUR(06141), TCP   )
      EQUIVALENCE (PCCUR(06061), TCV   )
      EQUIVALENCE (PCCUR(06541), TCWL1 )
      EQUIVALENCE (PCCUR(06621), TCWL2 )
      EQUIVALENCE (PCCUR(06701), TCWL3 )
      EQUIVALENCE (PCCUR(06301), TCWR1 )
      EQUIVALENCE (PCCUR(06381), TCWR2 )
      EQUIVALENCE (PCCUR(06461), TCWR3 )
      EQUIVALENCE (PCCUR(05561), TT    )
      EQUIVALENCE (PCCUR(03201), TS    )
      EQUIVALENCE (PCCUR(03521), VS    )
       EQUIVALENCE (PCCUR(00001), TPLOT )
      EQUIVALENCE (PCCUR(00481), VCPLT)
       EQUIVALENCE (PCCUR(00321), VPLOT )
      EQUIVALENCE (PCCUR(01281), WL1P  )
      EQUIVALENCE (PCCUR(01441), WL2P  )
      EQUIVALENCE (PCCUR(01601), WL3P  )
      EQUIVALENCE (PCCUR(04481), WL1S  )
      EQUIVALENCE (PCCUR(04641), WL2S  )
      EQUIVALENCE (PCCUR(04801), WL3S  )
      EQUIVALENCE (PCCUR(00801), WR1P  )
      EQUIVALENCE (PCCUR(00961), WR2P  )
      EQUIVALENCE (PCCUR(01121), WR3P  )
      EQUIVALENCE (PCCUR(04001), WR1S  )
      EQUIVALENCE (PCCUR(04161), WR2S  )
      EQUIVALENCE (PCCUR(04321), WR3S  )
       EQUIVALENCE (PCCUR(00161), ZPLOT )
      EQUIVALENCE (PCCUR(03361), ZS    )
      EQUIVALENCE(IOCCUR(00308), II    )
      EQUIVALENCE (IOCCUR(00301), IREF  )
      EQUIVALENCE (IOCCUR(00001), IOP   )
      EQUIVALENCE(IOCCUR(00310), JJ    )
      EQUIVALENCE (IOCCUR(00313), K     )
      EQUIVALENCE (IOCCUR(302), LPLOT )
      EQUIVALENCE (IOCCUR(00303), MODE  )
      EQUIVALENCE (IOCCUR(00091), NCOMDV)
      EQUIVALENCE(IOCCUR(00312), NCON  )
      EQUIVALENCE (IOCCUR(304), NCP   )
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      EQUIVALENCE (IOCCUR(CC305), NDECOY)
      EQUIVALENCE(IOCCUR(CC306), NDVCH )
      EQUIVALENCE (NOCCUR(3C), INALPH)
      EQUIVALENCE (NOCCUR(C7), LOPT  )
      EQUIVALENCE (NOCCUR(1C), MHEAT)
      EQUIVALENCE (NOCCUR(C3), MOPT  )
      EQUIVALENCE (NOCCUR(CC5), NOSEOP)
      EQUIVALENCE (NOCCUR(15), NGEOM)
      EQUIVALENCE (NOCCUR(22), NTHRST)
C
C
C
      XXX = 0.D0
C
C          CALLING THE TIMER SUBROUTINE TO RECORD THE START OF
C        CALCULATIONS BY THE PROGRAM.
  10C CALL TIMERS(1,TIMTAB)
C
 400  NDC = NDECOY
      NDVC = NDVCH
C
C SAVE OCCUR(133-145), OCCUR(205-209) AND OCCUR(222) IN DVAR(1-19)
      CALL SAVEDV(1,DVAR,OCCUR)
      IF(IREF.NE.2) GO TO 497
      IF(NDECOY.EQ.1) GO TO 497
      DO 111 I = 1, NDVCH
      NCON = NCOMDV(I)
C THE VALUE OF THE ITH DESIGN VARIABLE TO BE PERTURBED IS SAVED IN
C
C HOLD(1,I).  THIS VALUE WAS USED TO CALCULATE BASIC DECOY TRAJECTORY.
      HOLD(1,I) = OCCUR(NCON)
C
C HOLD(2,I) SAVES THE PERTURBED VALUE OF THIS VARIABLE TO BE USED FOR
C CALCULATING THE TRAJECTORY OF THE FIRST COMPARISON DECOY.
      HOLD(2,I) = DVL(I)
C
C HOLD(3,I) SAVES THE PERTURBED VALUE OF THIS VARIABLE TO BE USED FOR
C THE TRAJECTORY OF THE SECOND COMPARISON DECOY.
 111  HOLD(3,I) = DVH(I)
C
C FOR ONE PERTURBATION ONLY, THIS VALUE MUST BE SAVED IN HOLD(2,I).
C IF TWO PERTURBATIONS ARE MADE, THE SMALLER VALUE MUST BE SAVED IN
C            HOLD(2,I) AND THE LARGER IN HOLD(3,I).
 497  DO 777 II = 1,NDVC
      IF(IREF.NE.2) GO TO 498
      IF(NDECOY-2)401,402,403
C
C A BASIC DECOY TRAJECTORY WILL BE CALCULATED.
 401  NLOW = 1
      NHIGH = 1
      GO TO 404
C
C ONE COMPARISON DECOY TRAJECTORY WILL BE CALCULATED.
 402  NLOW = 2
      NHIGH = 2
      GO TO 404
C
C TWO COMPARISON DECOY TRAJECTORIES WILL BE CALCULATED.
 403  NLOW = 2
      NHIGH = 3
```

```
C
C   OCCUR(NCON) IS THE LOCATION OF THE DESIGN VARIABLE BEING PERTURBED.
 446   NCON = NCOMDV(II)
C
C RESTORE DVAR(1-19) TO OCCUR(133-145), OCCUR(205-209) AND OCCUR( 222)
       CALL SAVEDV(2,DVAR,OCCUR)
       GO TO 499
C
C IF IREF EQUALS ONE A REENTRY VEHICLE TRAJECTORY WILL BE CALCULATED.
C IF IREF EQUALS THREE REFERENCE VEHICLE TRAJECTORY DATA MUST BE INPUT.
498    NLOW = 1
       NHIGH = 1
499    DO 444 KK = NLOW,NHIGH
       IF(IREF.NE.2) GO TO 501
C
C PUT LOWER VALUE OF IITH DESIGN VARIABLE TO BE PERTURBED IN OCCUR ARRAY
       IF(KK.EQ.2) OCCUR(NCON) = DVL(II)
C
C PUT UPPER VALUE OF IITH DESIGN VARIABLE TO BE PERTURBED IN OCCUR ARRAY
       IF(KK.EQ.3) OCCUR(NCON) = DVH(II)
501    CONTINUE
       IF(MODE.NE.1) CASE = CASE & .001D0
       WRITE(6,1100)CASE,DATE,EMO
       IF(IREF.EQ.3) GO TO 28
C
C             TESTING THE INPUT QUANTITIES.
       IF(LOPT.LE.4)GO TO 53
       WRITE(6,1053)LOPT
       LOPT=1
    53 IF(NTHRST.LE.2)GO TO 54
       WRITE(6,1054)NTHRST
       NTHRST=0
    54 CONTINUE
       IF(NGEOM.LT.1)WRITE(6,1102)NGEOM
       IF(NGEOM.GT.3)WRITE(6,1102)NGEOM
       IF(NGEOM.LT.1)NGEOM=1
       IF(NGEOM.GT.3)NGEOM=1
       IF(INALPH.EQ.0)GO TO 5
       IF((LOPT*(LOPT-2)).EQ.0)WRITE(6,1077)LOPT
     5 CONTINUE
       IF(NOPT.NE.0)GO TO 55
       IF(MHEAT.NE.0)WRITE(6,1055)MHEAT
       IF(NOSEOP.NE.0)WRITE(6,1056)NOSEOP
    55 IF(MHEAT.NE.0)GO TO 56
       IF(NOSEOP.NE.0)WRITE(6,1057)NOSEOP
    56 CONTINUE
C
C             DEFINING NUMERICAL FACTORS.
       CODLAM=7.6489D-9*MW/(SIG*SIG)
       FACTR9=SQRT(GAMMA)
       ALALI=0.000
C
C             SETTING INPUT OPTIONS EQUAL TO A STORAGE QUANTITY IN ORDER
C          TO CARRY THEM OVER TO THE FOLLOWING INPUT CASE, UNLESS THEY ARE
C            REDEFINED.
       LOPTO=LOPT
       NTHRTO=NTHRST
       INALPO=INALPH
C
C             CHANGING THE UNITS FROM INCHES (INPUT UNITS) TO FEET (UNITS
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NOT REPRODUCIBLE

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C        USED INTERNALLY).
      RN1=RN1/12.0DC
      RB1=RB1/12.0DC
      LA1=LA1/12.0DC
      RN2=RN2/12.0DC
      RB2=RB2/12.0DC
      LA2=LA2/12.0DC
      DELZ=DELZ/12.0DC
      DELY=DELY/12.0DC
C
C           SETTING THE DRAG COEFFICIENT QUANTITIES TO ZERO.
      CDFINF(2,1,1)=0.DC
      CDFINF(2,2,1)=0.DC
      CDFINF(2,1,2)=0.DC
      CDFINF(2,2,2)=0.DC
      CDB=0.D0
      CDP=0.DC
      CDPC=0.D0
      CD1=0.DC
      DELCDP=0.0D0
      DECDFP=0.0D0
      DECFTC=0.0DC
      TZTEST=0.0D0
C
C           SETTING THE ROTATIONAL QUANTITIES TO ZERO.
      IF(LOPT.EQ.0)GO TO 201
        CP=0.0DC
        CN=0.0DC
      PSIC=0.0D0
        QC=0.0D0
      SMPC=0.0DC
      PHIC=0.0D0
      IF(LOPT.EQ.1)THEALC=0.0DC
  201 CONTINUE
      IF(LOPT.NE.0)GO TO 205
      DO 200 J=1,200
      TAMAX(J)=0.D0
       ZMAX(J)=0.DC
       FMAX(J)=0.DC
      ALMAX(J)=0.DC
      TAMIN(J)=0.DC
       ZMIN(J)=0.DC
       FMIN(J)=0.DC
  200 ALMIN(J)=0.DC
  205 CONTINUE
C
C           FINDING THE TRIGONOMETRIC FUNCTIONS OF THE THRUST OFFSET
C        ANGLES.
      CTHZET=COS(0.0174532SDC*THEZET)
      STHZET=SIN(0.0174532SDC*THEZET)
      CPSZET=COS(0.0174532SDC*PSIZET)
      SPSZET=SIN(0.0174532SDC*PSIZET)
C
C           CHANGING THE UNITS OF ANGLES FROM DEGREES TO RADIANS.
      GAMFC=0.0174532SDC*GAMFC
      SINGC=DSIN(GAMFC)
       PHIC=0.0174532SDC*PHIC
       PSIC=0.0174532SDC*PSIC
      THEALC=0.0174532SDC*THEALC
      ALST=0.0174532SDC*ALST
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C
C        SETTING THE MASS LOSS AND HEATING QUANTITIES TO ZERO.
      QDOT(1,1)=0.0D0
      QDOT(4,1)=0.0D0
      DO 3 J=1,9
      MDOT(1,J)=0.0D0
      MDOT(2,J)=0.0D0
      MDOT(3,J)=0.0D0
      MDOT(4,J)=0.0D0
      PERSB(J)=0.0D0
      QDOT(2,J)=0.0D0
    3 QDOT(3,J)=0.0D0
C
      WDOT=0.0D0
      PNDOT=0.0D0
      RBDOT=0.0D0
C
C        CALLING IN THE TIMER SUBROUTINE TO RECORD THE CALLING IN OF
C      SUBROUTINE VIXEN.
      CALL TIMERS(2,TIMTAB)
C
C        CALLING IN SUBROUTINE VIXEN WHICH PERFORMS THE CALCULATIONS.
      CALL VIXEN
C
C      PERFORM THE CALCULATIONS CALLED FOR BY VIXEN.
C        CALLING IN THE TIMER SUBROUTINE TO MEASURE THE TIME TO
C      CALCULATE THE TRAJECTORY.
      CALL TIMERS(-2,TIMTAB)
C
C
C        CALLING IN THE TIMER SUBROUTINE TO MEASURE THE TOTAL TIME TO
C      READ IN THE INPUT QUANTITIES AND PERFORM THE CALCULATIONS.
      CALL TIMERS(-1,TIMTAB)
C
C        SETTING THE THRUST QUANTITIES TO ZERO.
      TH=0.0D0
      MX=0.0D0
      MY=0.0D0
      MZ=0.0D0
      TBMAT(1)=0.0D0
      TBMAT(2)=0.0D0
      TBMAT(3)=0.0D0
C
C        CHANGING UNITS ON THE GEOMETRIC QUANTITIES FROM FEET BACK TO
C      INCHES.
      RN1=RN1*12.0D0
      RB1=RB1*12.0D0
      LA1=LA1*12.0D0
      RN2=RN2*12.0D0
      LA2=LA2*12.0D0
      RB2=RB2*12.0D0
      DELY=DELY*12.0D0
      DELZ=DELZ*12.0D0
C
C        CHANGING UNITS FROM RADIANS TO DEGREES TO PREPARE FOR NEW
C      CASE.
      ALST=ALST/0.0174532925D0
C
C        SETTING THE OPTIONS EQUAL TO THE STORAGE INPUT VALUES TO
C      PREPARE FOR A NEW CASE.
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```
      INALPH=INALPC
      NTFRST=NTHRTC
      LOPT=LOPTC
      IF(INCF.EQ.2) GO TO 30
 20   CALL HEADER(3)
C
C SAVE REENTRY VEHICLE TRAJECTORY DATA FOR POSSIBLE COMPARISON WITH THE
C TRAJECTORY OF A DECOY.
      DO 22 I = 1, LPLOT
       ZS(I) = ZPLOT(I)
       TS(I) = TPLOT(I)
      IF(IOP(73).EQ.0) GO TO 21
      IF(IOP(64).EQ.1) VS(I) = VPLOT(I)
      IF(IOP(65).EQ.1) DS(I) = VOGPLT(I)
      IF(IOP(66).EQ.1) BS(I) = BETAPL(I)
21    IF(IOP(74).EQ.0) GO TO 22
      IF(IOP(67).EQ.1) WL1S(I) = WL1P(I)
      IF(IOP(68).EQ.1) WL2S(I) = WL2P(I)
      IF(IOP(69).EQ.1) WL3S(I) = WL3P(I)
      IF(IOP(70).EQ.1) WR1S(I) = WR1P(I)
      IF(IOP(71).EQ.1) WR2S(I) = WR2P(I)
      IF(IOP(72).EQ.1) WR3S(I) = WR3P(I)
22    CONTINUE
C
      WRITE(6,1000)(ZS(I),TS(I),VS(I),DS(I),BS(I),I=1,LPLOT)
      IF(IOP(74).EQ.1)WRITE(6,1001)(ZS(I),TS(I),WR1S(I),WR2S(I),WR3S(I),
     1 WL1S(I),WL2S(I),WL3S(I), I=1,LPLOT)
      LP=LP
      IF(LP.LT.6)GO TO 407
C
C INTEGRATION ROUTINE HAS FAILED.  RESTORE DESIGN CHARACTERISTIC VALUES
C TO OCCUR ARRAY THEN TRY NEXT RV OR DECOY.
      WRITE(6,406)  LP
407   CONTINUE
      CALL SAVEDV(2,DVAR,OCCUR)
      RETURN
 30   CALL HEADER(NLOW)
C
C        THE DIFFERENCES BETWEEN THE REENTRY VEHICLE AND THE DECOY
C          QUANTITIES - V, V DOT OVER G, BETA, WAKE LENGTH AND RADAR
C          CROSS SECTION FOR THE INPUT RADAR FREQUENCIES.
      DO 33 I = 1, LPLOT
      IF(IOP(73).EQ.0) GO TO 31
      IF(IOP(64).EQ.1) DV(I) = VS(I) -VPLOT(I)
      IF(IOP(65).EQ.1) DD(I) = DS(I) -VOGPLT(I)
      IF(IOP(66).EQ.1) DB(I) = BS(I) -BETAPL(I)
31    IF(IOP(74).EQ.0) GO TO 33
      IF(IOP(67).EQ.1) DWL1(I) = WL1S(I) -WL1P(I)
      IF(IOP(68).EQ.1) DWL2(I) = WL2S(I) -WL2P(I)
      IF(IOP(69).EQ.1) DWL3(I) = WL3S(I) -WL3P(I)
      IF(IOP(70).EQ.1) DWR1(I) = WR1S(I) -WR1P(I)
      IF(IOP(71).EQ.1) DWR2(I) = WR2S(I) -WR2P(I)
      IF(IOP(72).EQ.1) DWR3(I) = WR3S(I) -WR3P(I)
33    CONTINUE
C
      WRITE(6,1000)(ZPLOT(I),TPLOT(I),VPLOT(I),VOGPLT(I),BETAPL(I),I=1,
     1LPLOT)
      IF(IOP(74).EQ.1)WRITE(6,1001)(ZPLOT(I),TPLOT(I),WR1P(I),WR2P(I),
     1WR3P(I),WL1P(I),WL2P(I),WL3P(I),I=1,LPLOT)
      LP=LP
```

```
      IF(LP.LT.6)GO TO 507
C
C INTEGRATION ROUTINE HAS FAILED.  RESTORE DESIGN CHARACTERISTIC VALUES
C TO OCCUR ARRAY THEN TRY NEXT RV OR DECOY.
      WRITE(6,406) LP
      CALL SAVEDV(2,DVAR,OCCUR)
      WRITE(6,4666) (DV(I),DD(I),DB(I),I=1,LPLOT)
4666  FORMAT(1H0 8X7HDELTA VRX7HDELTA D3X7HDELTA B/(1H 1P3E15.7))
      GO TO 777
507   CONTINUE
C
C THE SEQUENCE OF STATEMENTS ENDING AT 50 COMBINES THE H AND ZPLOT ARRAY
C THE ZPLOT ARRAY HAS THE ALTITUDES AT WHICH TRAJECTORY DATA IS OUTPUT.
C THE TPLOT ARRAY HAS THE CORRESPONDING TIMES.
C THE H ARRAY HAS THE ALTITUDES AT WHICH CORRIDOR VALUES ARE INPUT.
C TO FORM THE TT ARRAY.THEN THE TIME CORRESPONDING TO EACH H IS FOUND BY
C LINEAR INTERPOLATION AND COMBINED WITH THE TPLOT ARRAY TO GIVE THE
C TTM ARRAY OF TIMES CORRESPONDING TO THE TT ALTITUDE ARRAY.
      JB = 2
      K = 0
      DO 50 I = 1, LPLOT
      JA = JB
      DO 44 J = JA, NCP
      K = K & 1
       IF(ZPLOT(I)-H(J)) 35,36,37
35    JB = J & 1
       TT(K) = H(J)
      CALL LINFIT(2,2,ZPLOT(I),TPLOT(I),WW,XX)
      TTM(K)=WW*H(J)&XX
      GO TO 44
36    JB = J  & 1
       TT(K) = ZPLOT(I)
       TTM(K)=TPLOT(I)
      GO TO 50
37     TT(K) = ZPLOT(I)
       TTM(K)=TPLOT(I)
      GO TO 50
44    CONTINUE
50    CONTINUE
C
95     DO 333 JJ = 1,LPLOT
       SAVE(1,JJ,KK) = DV(JJ)
       SAVE(2,JJ,KK) = DD(JJ)
       SAVE(3,JJ,KK) = DB(JJ)
       SAVE(4,JJ,KK) = DWL1(JJ)
       SAVE(5,JJ,KK) = DWL2(JJ)
       SAVE(6,JJ,KK) = DWL3(JJ)
       SAVE(7,JJ,KK) = DWR1(JJ)
       SAVE(8,JJ,KK) = DWR2(JJ)
       SAVE(9,JJ,KK) = DWR3(JJ)
333      CONTINUE
C
C
      NDOCOY = 1
       IF(KK.EQ.NEIGH.AND.NDECOY.EQ.2) NDOCOY = 2
       IF(KK.EQ.NEIGH.AND.NDECOY.EQ.3) NDOCOY = 3
C
C INCLUDE CAN PRODUCE AND OUTPUT FIRST AND SECOND DIFFERENCES BETWEEN
C BASIC DECOY DATA AND COMPARISON DECOY DATA SAVED IN DO 333 LOOP
C AT SPECIFIED ALTITUDES AND PRODUCE SCATTER PLOTS OF THE SAVED
```

```
C DIFFERENCES VS THE VALUE OF THE DESIGN VARIABLE BEING VARIED
C THERE WILL BE THREE POINTS ON EACH GRAPH.
      IF(IOP(73).EQ.0) GO TO 600
      IF(IOP(64).EQ.1)
     1CALL  INTGRL(1,2,1,3915,3953,BCV,DV,TCV,SV,8H VELCCTY)
      IF(IOP(65).EQ.1)
     1CALL  INTGRL(2,2,4,3916,3954,BCD,DD,TCD,SD,8H DECELRN)
      IF(IOP(66).EQ.1)
     1CALL  INTGRL(3,3,7,3917,3955,BCB,DB,TCB,SB,8H BALLSTC)
600   IF(IOP(74).EQ.0) GO TO 444
      IF(IOP(67).EQ.1)
     1CALL  INTGRL(22,6,10,3941,3956,BCWL1,DWL1,TCWL1,SWL1,8H WAKE L1)
      IF(IOP(68).EQ.1)
     1CALL  INTGRL(23,6,13,3942,3957,BCWL2,DWL2,TCWL2,SWL2,8H WAKE L2)
      IF(IOP(69).EQ.1)
     1CALL  INTGRL(24,6,16,3943,3958,BCWL3,DWL3,TCWL3,SWL3,8H WAKE L3)
      IF(IOP(70).EQ.1)
     1CALL  INTGRL(25,6,19,3944,3959,BCWR1,DWR1,TCWR1,SWR1,8H WAKE R1)
      IF(IOP(71).EQ.1)
     1CALL  INTGRL(26,6,22,3945,3960,BCWR2,DWR2,TCWR2,SWR2,8H WAKE R2)
      IF(IOP(72).EQ.1)
     1CALL  INTGRL(27,6,25,3946,3961,BCWR3,DWR3,TCWR3,SWR3,8H WAKE R3)
444       CONTINUE
C
777   CONTINUE
C
C
C
      CALL SAVEDV(2,DVAR,DCCLR)
      RETURN
C
406   FORMAT(1H0 'CASE FAILED. TRY NEXT DESIGN VARIABLE' ,'LP =',I12)
700   FORMAT(1H0 'REENTRY VEHICLE CHARACTERISTICS')
900   FORMAT(1H0 'DECOY CHARACTERISTICS')
1000  FORMAT(
     11H0/7X'ALTITUDE'11X'TIME'7X'VELOCITY'3X'DECELERATION'11X'BETA'/
     2(1H F15.1,4F15.2))
1001  FORMAT(1H07X8HALTITUDE11X4HTIME8X7HWAKE R18X7HWAKE R28X7HWAKE R3
     2 8X7HWAKE L18X7HWAKE L28X7HWAKE L3/(1H F15.1,F15.2,1P3E15.7,
     3  0P3F15.2))
1800   FORMAT(1H1'INTEGRAL OF',1X,A8,' =',1PE16.7)
1100   FORMAT(1H110X'CASE ',F5.3,5X'DATE ',F7.2,5X'MEMO ',F7.1,5X'2542E')
1052 FORMAT(1H0 10X,24H*****WARNING***** NGEOM=I3,23H IS THE SAME AS NG
     1EOM=1)
1053 FORMAT(1H0,10X,'*****WARNING***** LOPT=',I3,' IS NOT ALLOWED, LOPT
     1 HAS BEEN SET EQUAL TO 1')
1054 FORMAT(1H0,10X,'*****WARNING***** NTHRUST=',I3,' IS NOT ALLOWED,
     1NTHRUST HAS BEEN SET EQUAL TO 0')
1055 FORMAT(1H0 10X,35H*****WARNING***** MOPT=0 AND MHEAT=I3,23H IS THE
     1 SAME AS MHEAT=0)
1056 FORMAT(1H0 10X,36H*****WARNING***** MOPT=0 AND NOSECP=I3,24H IS THE
     1E SAME AS NOSECP=0)
1057 FORMAT(1H0 10X,37H*****WARNING***** MHEAT=0 AND NOSECP=I3,24H IS T
     1HE SAME AS NOSECP=0)
1077 FORMAT(1H0,10X,'******WARNING******'/ 11X,'INPUT ALPHA OPTION OVER
     1RIDES LOPT=',I3,' ROTATIONAL CALCULATIONS')
      END
```

```
CGIMAX
        IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE  GIMAX(AA,BB,NF,NMIMAX,ACCUR,NFUNC,XMIMAX,YMIMAX)
      IW=6
      DIMENSION E(100)
      COMMON /END/ ITERM
C
C
C          SUBROUTINE GIMAX, THE CONTROLLING SUBROUTINE FOR THE TWO
C        VARIABLE FIBONACCI SEARCH TECHNIQUE, OPTIMIZES THE SECONDARY
C         INDEPENDENT VARIABLE OF THE FUNCTION. AT EACH EVALUATION POINT
C         IN THIS OPTIMIZATION, GIMAX SUMMONS FUNCTION GMIMAX WHICH
C         CALLS FOR THE OPTIMIZATION OF THE PRIMARY VARIABLE.
C
C
      A=AA
      B=BB
      IF (NMIMAX) 10,11,11
   10 JMIMAX=1
      GO TO 20
   11 JMIMAX=2
   20 IF (B-A) 21,22,23
   21 TEMP=A
      A=B
      B=TEMP
      GO TO 23
   22 L=1
   25 WRITE (IW,26)  L
   26 FORMAT(17H0  ERROR OF  TYPE  I2)
      ITERM = 1
      GO TO 170
   23 R=B-A
      IF (NFUNC) 31,30,35
   30 IF (ACCUR) 31,31,40
   31 L=2
      GO TO 25
   35 NFUNC2=NFUNC&2
      R1=(1.0D0&SQRT (5.0D0))/2.0D0
      R2=(1.0D0-SQRT (5.0D0))/2.0D0
      ROACC=(R1**NFUNC2-R2**NFUNC2)/(R1-R2)
      GO TO 45
   40 ROACC=R/ACCUR
   45 IF (ROACC-2.0D0) 50,50,51
   50 XMIMAX=(A&B)/2.0D0
      YMIMAX=GMIMAX(XMIMAX,NF)
      GO TO 170
   51 IF (ROACC-3.0D0) 60,60,61
   60 XL=A&(B-A)/3.0D0
      XR=A&2.0D0*(B-A)/3.0D0
      YL=GMIMAX(XL,NF)
      IF(ITERM.NE.0) GO TO 160
      YR=GMIMAX(XR,NF)
      IF(ITERM.NE.0) GO TO 151
      IF(YL-YR) 70,70,71
   70 XMIMAX=XR
      YMIMAX=YR
      GO TO 170
   71 XMIMAX=XL
      YMIMAX=YL
```

```
      GO TO 170
   61 K=3
      F(1) = 1.0D0
      F(2)=1.0D0
   74 F(K)=F(K-1)&F(K-2)
      IF (ROACC-F(K)) 80,80,75
   75 IF (K-40) 77,76,76
   76 L=3
      GO TO 25
   77 K=K&1
      GO TO 74
   80 N=K
      XL=A&F(N-2)*R/F(N)
      XR=A&F(N-1)*R/F(N)
      YL=GMIMAX(XL,NF)
      IF(ITERM.NE.0) GO TO 160
      YR=GMIMAX(XR,NF)
      IF(ITERM.NE.0) GO TO 150
      J=1
   90 NJ=N-J
      NJONE=N-J-1
      NJTWO=N-J-2
      GO TO (100,101), JMIMAX
  100 IF (YR-YL) 130,130,110
  101 IF (YR-YL) 110,110,130
  110 IF (J-N&3) 120,160,160
  120 B=XR
      A=A
      R=B-A
      XR=XL
      XL=A&F(NJTWO)*R/F(NJ)
      YR=YL
      YL=GMIMAX(XL,NF)
      IF(ITERM.NE.0) GO TO 160
  125 J=J&1
      GO TO 90
  130 IF (J-N&3) 140,150,150
  140 B=B
      A=XL
      R=B-A
      XL=XR
      XR=A&F(NJONE)*R/F(NJ)
      YL=YR
      YR=GMIMAX(XR,NF)
      IF(ITERM.NE.0) GO TO 150
      GO TO 125
  150 XMIMAX=XR
      YMIMAX=YR
      GO TO 170
  160 XMIMAX=XL
      YMIMAX=YL
  170 RETURN
      END
```

```
CGMIMAX
      IMPLICIT REAL*8 (A-H, O-Z)
      FUNCTION GMIMAX(X,NF)
      COMMON /END/ ITERM
      COMMON /XXSAVE/ X1SAVE(40), X2SAVE(40), KOUNT
      COMMON/MINSK/N,K,ALB(20),UB(20),XX(20),F1
      COMMON/IOPT/IPROC,IN,NCONS,IPNT,ICX,LIMIT,IRAND
      COMMON/FOPT/ERR,PRAND, FAC, DELTA
C
C
C          FUNCTION GMIMAX, PART OF THE TWO VARIABLE FIBONACCI SEARCH
C       TECHNIQUE, MINIMIZES THE PRIMARY VARIABLE FOR EACH STEP IN THE
C       OPTIMIZATION OF THE SECONDARY VARIABLE.
C
C
  2   XX(2) = X
      CALL MIMAX(ALB(1),UB(1),3,-1,ERR,LIMIT,XX(1),VAL)
      GMIMAX  = VAL
      KOUNT = KOUNT & 1
      IF(KOUNT.GT.40) ITERM = 1
      IF(KOUNT.GT.40) RETURN
      X1SAVE(KOUNT) = XX(1)
      X2SAVE(KOUNT) = XX(2)
 1000 RETURN
      END
```

```
CGRAM
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE GRAM
      COMMON/IOPT/IPROC,NMAX,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON/BLKO/HH(1600),X(40),D(40),E(40),DP(40),A(40),
     1 B(40),GS,GSP,GTP,GSS,GTT,GSB,FZZ,FP,FB,FC,Z,PZZ,TC,RS,SL,ZZZ,
     1OZZ,AXX,FL,
     2DFLXX,FAK,CXX(40,10)
      COMMON OCCUR,NOCCUR
      DIMENSION OCCUR(4000),NOCCUR(30),BB(20,20),C(20,20)
      EQUIVALENCE(HH(1),BB(1)),(HH(401),C(1))
C
C
C         SUBROUTINE GRAM USES THE GRAM-SCHMIDT ORTHOGONALIZATION
C       PROCESS.  GIVEN A MATRIX C AND A COLUMN VECTOR D, THIS ROUTINE
C       DEFINES A SET OF VECTORS, A, WHICH ARE USED TO CALCULATE AN
C       ORTHOGONAL SET OF VECTORS, B, TO BE USED AS THE ROW VECTORS OF
C       A MATRIX BB.  THE INPUT MATRIX C IS THEN REDEFINED AS THE
C       INVERSE (TRANSPOSE) OF THE MATRIX BB.
C
C
      DO 1 II = 1,NMAX
      A(II) = 0.D0
      B(II) = 0.D0
      DO 1 JJJ = 1,NMAX
      BB(II,JJJ) = 0.D0
    1 CONTINUE
C
C
      DO 107 I=1,NMAX
C
      DO 101 L=1,NMAX
      A(L) = 0.D0
      DO 101 N=1,NMAX
      A(L)=A(L)&C(L,N)*D(N)
  101 CONTINUE
C
      DO 102 L=1,NMAX
      IF(I-1) 111,111,112
  111 B(L)=A(L)
      GO TO 102
  112 IL=I-1
      DO 103 J=1,IL
      AB = 0.D0
      DO 104 K=1,NMAX
      AB=AB&A(K)*BB(J,K)
  104 CONTINUE
      B(L)=A(L)-AB*BB(J,L)
  103 CONTINUE
C
  102 CONTINUE
C
      BMAGS = 0.D0
      DO 106 L=1, NMAX
      BMAGS=BMAGS&B(L)**2
  106 CONTINUE
      BMAG=SQRT(BMAGS)
C
C
```

```
      DO 107 L=1,NMAX
      BB(I,L)=B(L)/BMAG
 107  CONTINUE
C
C
C        C MATRIX IS INVERSE OF BB MATRIX. THIS INVERSE IS THE TRANSPOSE
      DO 108 I=1,NMAX
      DO 108 J=1, NMAX
      C(J,I)=BB(I,J)
  108 CONTINUE
C
C
      WRITE(6,5)
  5   FORMAT(1H018HC MATRIX FROM GRAM)
C
      DO 3 I = 1,NMAX
    3 WRITE(6,2) (C(I,J),J=1,NMAX)
  2   FORMAT(1H 6(F20.10))
C
      RETURN
      END
```

```
CHEADER
      IMPLICIT REAL*8(A-H,O-Z)
      SUBROUTINE HEADER(K)
      COMMON OCCUR, NOCCUR
      DIMENSION OCCUR(4000), NOCCUR(30)
      EQUIVALENCE(OCCUR(4000),LP)
C
C
C          SUBROUTINE HEADER PRINTS THE TYPE OF VEHICLE WHOSE TRAJECTORY
C        IS BEING PROCESSED ALONG WITH THE VALUES OF NINETEEN DESIGN
C        PARAMETERS, THE VALUE OF NGEOM, AND THE VALUE OF LP, AN ERROR
C        TEST PARAMETER.
C
C
      K = K
      GO TO(10, 20, 30), K
10    WRITE(6,700)
      GO TO 40
20    WRITE(6,800)
      GO TO 40
30    WRITE(6,900)
40    CONTINUE
      WRITE(6,1000)(OCCUR(I),I=133,145),(OCCUR(I),I=205,209),OCCUR(222),
     1NOCCUR(15),LP
 1000 FORMAT(1H0'              W1          THETA1              RN1            RB1         L
     1AMDA1              LA1              W2          THETA2              RN2              RB2'
     2/1H 10E12.2/1H
     *                   '           LAMDA2              LA2            ZTURN              ZON
     3         ZOFF              THO              TON             TOFF              ISP NGEOM
     4 LP'/1H 2E12.2,1PE12.4,0P6E12.2,2I6)
700   FORMAT(1H0 'BASIC DECOY CHARACTERISTICS')
800   FORMAT(1H0 'COMPARISON DECOY CHARACTERISTICS')
900   FORMAT(1H0 'REFERENCE REENTRY VEHICLE CHARACTERISTICS')
      RETURN
      END
```

```
CINFCOF
      SUBROUTINE INFCOF(DC,IZ,XO)
      IMPLICIT REAL*8(A-H,O-Z)
      REAL*4 DC, XO
      COMMON OCCUR, NOCCUR
      COMMON /CPCCUR/ PCCUR(11770)
      COMMON /CICCUR/ IOCCUR(320)
      DIMENSION DC(2),H(3,50),IZ(19),NOCCUR(30),OCCUR(4000)
       DIMENSION  XO(40)
      DIMENSION    S(9,160,3), T(160), Z(160)
      EQUIVALENCE (PCCUR(07101), H     )
      EQUIVALENCE (PCCUR(07251), S     )
      EQUIVALENCE (PCCUR(00001), T     )
      EQUIVALENCE (PCCUR(00161), Z     )
      EQUIVALENCE(IOCCUR(000309), II     )
      EQUIVALENCE(IOCCUR(000310), JJ     )
      EQUIVALENCE (IOCCUR(00305), NDECOY)
      EQUIVALENCE (IOCCUR(00302), LPLOT )
      EQUIVALENCE(IOCCUR(000312), NCON   )
C
C
C           SUBROUTINE INFCOF CALCULATES A TABLE OF INFLUENCE COEFFI-
C        CIENTS AND POSSIBLY SECOND DERIVATIVES AT EACH ALTITUDE FOR
C        WHICH VIXEN STORES TRAJECTORY INFORMATION.
C
C
      DO 27 I = 1, 19
      JP = I
      IF(IZ(I).EQ.NCON) GO TO 31
27    CONTINUE
C
      JP = 0
31    CONTINUE
C
      JP = JP & JP
      X21 = H(2,II)-H(1,II)
      IF(NDECOY.EQ.2) GO TO 100
      X32 = H(3,II)-H(1,II)
      X31 = (H(3,II)-H(2,II))/2.DC
      GO TO 500
 100  AMID= .5DC*(H(1,II)&H(2,II))
      IF(JP.EQ.0)GO TO 102
      WRITE(6,1000, XO(JP-1)  , XO(JP) ,(H(K,II),K=1,2), AMID
      GO TO 103
 102  WRITE(6,1050)NCON   ,(H(K,II),K=1,2) ,AMID
 103  WRITE(6,1100) DC
      WRITE(6,1200)
      DO 222 I = 1, LPLOT
      XA = S(JJ,I,2) -S(JJ,I,1)
      XA = XA/X21
170   WRITE(6,1300)Z(I),T(I),(S(JJ,I,K),K=1,2),XA
222   CONTINUE
      RETURN
C
C
 500  AMID = .5DC*(H(1,II)&H(2,II))
      BMID = .5DC*(H(1,II)&H(3,II))
      CMID = .5DC*(H(2,II)&H(3,II))
      IF(JP.EQ.0)GO TO 502
```

```
      WRITE(6,950) XQ(JP-1) , XQ(JP)
      GO TO 504
502   WRITE(6,1025) NCON
504   WRITE(6,1400)           (H(K,II),K=1,3),AMID,BMID,CMID
503   WRITE(6,1100) DC
            WRITE(6,1500)
C
C
      DO 555 I = 1, LPLOT
      XA= S(JJ,I,2)-S(JJ,I,1)
      XB= S(JJ,I,3) -S(JJ,I,1)
      XA = XA/X21
      XB = XB/X32
      XC = (XB-XA)/X31
530   WRITE(6,1600)Z(I),T(I),(S(JJ,I,K),K=1,3),XA,XB,XC
555   CONTINUE
      RETURN
C
C
717   FORMAT(16A4)
 950  FORMAT(1H 2A4,16HVARIES 32X 10HVALUES ARE 33X 14HMIDPOINTS ARE  )
1025  FORMAT(1H I8,' VARIES',32X'VALUES  ARE',33X'MIDPOINTS ARE')
 1050 FORMAT(1H0I8,' VARIES VALUES ARE',4X2F15.2,' MIDPOINT IS',F15.2)
1000  FORMAT(1H02A4,17HVARIES VALUES ARE 2F15.2,1X 11HMIDPOINT IS 1X ,
     1F15.2)
1100   FORMAT(1H 5HDELTA 2A4, 1X 5HTABLE)
1200  FORMAT(1H 7X'ALTITUDE',11X'TIME',4X'FIRST DELTA',3X'SECOND DELTA',
     14X'INFLU COEFF')
1300  FORMAT(1H F15.1,4F15.2)
1400  FORMAT (1H 30X6F15.2)
1500  FORMAT(1H 7X'ALTITUDE',11X'TIME',4X'FIRST DELTA',3X'SECOND DELTA',
     14X'THIRD DELTA FIRST INF COEF SECON INF COEF',5X' 2ND DERIV')
1600  FORMAT(1H F15.1,7F15.2)
      END
```

```
CINTERP
      SUBROUTINE INTERP(M,N,W,X,Y,Z)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION X(M), Y(M)
C
C
C        GIVEN THE TWO TABLES X AND Y(X) AND A PARTICULAR VALUE OF X
C       CALLED W.  SUBROUTINE INTERP FINDS Z EQUAL TO Y(W) BY LINEAR
C       INTERPOLATION.
C
C       M IS THE DIMENSION GIVEN X AND Y IN  THE CALLING PROGRAM.
C       X IS THE INDEPENDENT VARIABLE ARRAY.  IT CONTAINS N ELEMENTS.
C       Y IS THE DEPENDENT VARIABLE ARRAY.  IT CONTAINS N ELEMENTS.
C       W IS A GIVEN VALUE OF X FOR WHICH THE CORRESPONDING VALUE OF
C       Y IS TO BE FOUND.
C       Z IS THE VALUE OF Y FOUND TO CORRESPOND WITH W.
C
C       THIS VALUE IS FOUND BY LINEAR INTERPOLATION.
C
C        IF N IS LESS THAN 1 OR GREATER THAN M, AN ERROR MESSAGE IS
C       WRITTEN AND THE RUN IS TERMINATED.
C
C        THE ELEMENTS OF THE X ARRAY SHOULD BE EITHER MONOTONICALLY
C     INCREASING OR MONOTONICALLY DECREASING.
C
C       NO CHECK IS MADE FOR SUCH CONSISTENCY.
C
C        IF W IS OUTSIDE THE RANGE OF X, THE VALUE OF Z WILL BE FOUND
C        BY EXTRAPOLATION USING THE FIRST TWO OR THE LAST TWO POINTS
C        AS APPROPRIATE.
C
      IF(N.GT.0.AND.N.LE.M) GO TO 20
      WRITE(6,10) M, N
   10 FORMAT(1H0 11HDIMENSION = I12, 1X 12HTABLE SIZE = I12)
      CALL EXIT
C
C
   20 IF(X(1).LT.X(2)) GO TO 50
      DO 22 I = 2, N
      IF(W.GE.X(I)) GO TO 40
   22 CONTINUE
C
   30 I = N
   40 Z = ((Y(I)-Y(I-1))/(X(I)-X(I-1)))*(W-X(I-1)) & Y(I-1)
C
      RETURN
C
C
   50 DO 55 I = 2, N
      IF(W.LE.X(I)) GO TO 40
   55 CONTINUE
      GO TO 30
C
      END
```

```
C INTGRL
      SUBROUTINE INTGRL(KA,KB,LX,KD,KE,Q,R,S,SIG,DC)
      IMPLICIT REAL*8(A-H,O-Z)
       REAL * 4 DC, XQ
      COMMON OCCUR,NOCCUR
      COMMON /CPCCUR/ PCCUR(11770)
      COMMON /CICCUR/ IOCCUR(320)
       COMMON /TTMCOM/ TTM
      COMMON /INFTST/ NDECOY
       DIMENSION OCCUR(4000), NOCCUR(30)
      DIMENSION A(27),B(40),C(40),D(160),E(160),F(40),G(40),H(40)
      DIMENSION IOP(90),IZ(19),Q(40),R(160),S(40),SIG(40),T(200)
      DIMENSION ZZ(200) , DC(2)
      DIMENSION TPLOT(160),TTM(200),XQ(40),XX(200),YY(200),Z(160)
       EQUIVALENCE (PCCUR(11571), A      )
      EQUIVALENCE (PCCUR(05841), H      )
      EQUIVALENCE (PCCUR(11759), HDIF   )
      EQUIVALENCE (PCCUR(05561), T      )
      EQUIVALENCE (PCCUR(00001), TPLOT  )
      EQUIVALENCE (PCCUR(00161), Z      )
      EQUIVALENCE (IOCCUR(00001), IOP   )
      EQUIVALENCE(IOCCUR(000310),JJ)
      EQUIVALENCE (IOCCUR(00313), KK    )
      EQUIVALENCE (IOCCUR(00302), LPLOT )
      EQUIVALENCE (IOCCUR(00304), NCP   )
       EQUIVALENCE (PCCUR(04961), B     )
       EQUIVALENCE (PCCUR(05001), C     )
       EQUIVALENCE (PCCUR(05041), D     )
       EQUIVALENCE (PCCUR(05201), E     )
       EQUIVALENCE (PCCUR(05361), F     )
       EQUIVALENCE (PCCUR(05401), G     )
      DATA IZ/133,134,135,136,137,138,139,140,141,142,143,144, 145,
     * 205,206,207,208,209,222/
      DATA XQ/160HW1        THETA1  RN1      RB1      LAMDA1  LA1      W2
     1 THETA2  RN2      RB2      LAMDA2  LA2      ZTURN   ZON      ZOFF
     2THO      TON      TOFF     ISP      ERROR   /
C
C
C        SUBROUTINE INTGRL PERFORMS ONE OF FOUR MAIN TASKS DEPENDING
C      UPON CERTAIN INPUT OPTIONS.  THESE ARE  (1) TO EVALUATE A
C      CORRIDOR INTEGRAL AND PRINT A TABULAR ARRAY OF DATA AT EACH
C      OF A NUMBER OF ALTITUDES.  (2)  TO EVALUATE A SIGMA SQUARE
C      INTEGRAL WHICH IS USED IN THE CALCULATIONS OF SUBROUTINE
C      EFFECT.  (3)  TO CALL THE PLOT ROUTINE TO OBTAIN A CORRIDOR
C      PLOT.  (4)  TO CALL THE PLOT ROUTINE TO OBTAIN AN INFLUENCE
C      COEFFICIENT PLOT.
C
C
      JJ = (LX&2)/3
      IF(IOP(KA&2*KB).EQ.0) GO TO 1120
      KO = IOP(KA&4*KB)
      IF(KO.EQ.1) WRITE(6,1000) DC
       JGO = 0
      IF(IOP(KA&3*KB).EQ.1) JGO = 30
      CALL LINFIT(40,NCP,H,Q,B,C)
      CALL LINFIT(40,NCP,H,S,F,G)
      CALL LINFIT(160,LPLOT,Z,R,D,E)
      MX = 1
      ITEST = 0
```

```
      DA = 0.D0
      DB = 0.D0
      Q1 = B(1)*Z(1) & C(1)
      R1 = D(1)*Z(1) & E(1)
      S1 = F(1)*Z(1) & G(1)
      XX(1) = Q1
      YY(1) = R1
      ZZ(1) = S1
      IF(R1.GT.S1) NX = 2
      IF(R1.LT.Q1) NX = 0
      IF(KQ.EQ.0)GO TO 40
      IF(NX.NE.1) ITEST = 1
      IF(NX.NE.1) DP = Z(1)
      IF(NX-1) 10, 30, 20
 10   WRITE(6,1100) Z(1), TPLOT(1),Q1 , R1 , S1, DA, Z(1)
      GO TO 40
 20   WRITE(6,1100) Z(1), TPLOT(1),Q1 , R1 , S1 , DA, Z(1)
      GO TO 40
 30   WRITE(6,1100) Z(1) , TPLOT(1), Q1, R1, S1, DA
C
 40   NS = LPLOT -1
      NR = NCP -1
C
C
      DO 1111 M = 2, KX
      DO 44 K = 2, NCP
      J = K -1
      IF(T(M).GE.H(K)) GO TO 50
 44   CONTINUE
      J = NR
 50   DO 55 K = 2, LPLOT
      I = K -1
      IF(T(M).GE.Z(K)) GO TO 60
 55   CONTINUE
       I = NS
 60   Q2 = B(J)*T(M) & C(J)
      R2 = D(I)*T(M) & E(I)
      S2 = F(J)*T(M) & G(J)
      XX(M) = Q2
      YY(M) = R2
      ZZ(M) = S2
        NY = 4
      IF(R2.GT.S2) NY = 7
      IF(R2.LT.Q2) NY = 1
      IGO = NX & NY
C
C
      GO TO(100,200,300,400,500,600,700,800,900),IGO
 100  T2 = 0.D0
      T1 = T(M-1)
      DA = DA & ADD(LX,T1,T(M),B(J),C(J),D(I),E(I),A)
      CALL WRITEM(JGO&10,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      GO TO 999
 200  T1 = T(M-1)
      T2 = -(C(J)-E(I))/(B(J)-D(I))
      DA = DA & ADD(LX,T2,T(M),B(J),C(J),D(I),E(I),A)
      CALL WRITEM(JGO&20,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      IF(ITEST.EQ.0) GO TO 950
      GO TO 999
 300  T2 = -(E(I)-G(J))/(D(I)-F(J))
```

```
      T1 = T(M-1)
      DA = DA & ADD(LX,T1,T2,D(I),F(I),F(J),G(J),A)
      CALL WRITEM(JGO&20,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      IF(ITEST.EQ.1) GO TO 350
      ITEST = 1
      DB = T2
350   T2 = -(C(J)-E(I))/(B(J)-D(I))
      DA = DA & ADD(LX,T2,T(M),B(J),C(J),D(I),E(I),A)
      CALL WRITEM(JGO&30,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      GO TO 999
400   T1 = T(M-1)
      T2 = -(C(J)-E(I))/(B(J)-D(I))
      DA = DA & ADD(LX,T1,T2,B(J),C(J),D(I),E(I),A)
      CALL WRITEM(JGO&20,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      IF(ITEST.EQ.0) GO TO 950
      GO TO 999
500   T1 = T(M-1)
      T2 = 0.D0
      CALL WRITEM(JGO&10,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      GO TO 999
600   T1 = T(M-1)
      T2 = -(F(I)-G(J))/(D(I)-F(J))
      DA = DA & ADD(LX,T1,T2 ,D(I),E(I),F(J),G(J),A)
      CALL WRITEM(JGO&20,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      IF(ITEST.EQ.0) GO TO 950
      GO TO 999
700   T2 = -(C(J)-E(I))/(B(J)-D(I))
      T1 = T(M-1)
      DA = DA & ADD(LX,T1,T2,B(J),C(J),D(I),E(I),A)
      CALL WRITEM(JGO&20,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      IF(ITEST.EQ.1) GO TO 750
      ITEST = 1
      DB = T2
750   T2 = -(F(I)-G(J))/(D(I)-F(J))
      DA = DA & ADD(LX,T2,T(M),D(I),E(I),F(J),G(J),A)
      CALL WRITEM(JGO&30,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      GO TO 999
800   T1 = T(M-1)
      T2 = -(E(I)-G(J))/(D(I)-F(J))
      DA = DA & ADD(LX,T2,T(M),D(I),E(I),F(J),G(J),A)
      CALL WRITEM(JGO&30,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      IF(ITEST.EQ.0) GO TO 950
      GO TO 999
900   T1 = T(M-1)
      T2 = 0.D0
      DA = DA & ADD(LX,T1,T(M),D(I),E(I),F(J),G(J),A)
      CALL WRITEM(JGO&10,T(M),TTM(M),Q2,R2,S2,DA,T2,D( I ),KQ)
      GO TO 999
950   ITEST = 1
      DB = T2
999    NX=NY/3
1111   CONTINUE
C
C
      OCCUR(KD) = DA
      OCCUR(KD&KB) = DB
      IF(KQ.EQ.0) WRITE(6,1900) DC, DA, DB
C
1120  IF(IOP(KA&KB).EQ.0) GO TO 2300
      SUM = 0.D0
```

```
      RLO = (R(1)/SIG(1))**2
      DO 2222 I = 2, NCP
      CALL INTERP(160,LPLOT,H(I),Z,P,RHI)
      RHI = (RHI/SIG(I))**2
      SUM = SUM - (RLO & RHI)*(H(I) -H(I-1))*.500
      RLO = RHI
 2222 CONTINUE
      OCCUR(KE) = SUM
      HDIF = H(1) -H(NCP)
      WRITE(6,1800) DC, SUM
C
 2300 IF(IOP(KA).EQ.0) GO TO 4000
      CALL AVPLT(XO,IZ,XX,YY,ZZ,2,DC)
 4000 IF(NDECOY.LT.2) RETURN
      IF(IOP(KA&5*KB).EQ.1) CALL INFCOF(DC,IZ,XO)
      IF(NDECOY.LT.3) RETURN
      IF(IOP(KA&6*KB).EQ.1) CALL AVPLT(XO,IZ,T,T,T,1,DC)
      RETURN
C
 1000 FORMAT(1H0 6X 8HALTITUDE 10X 4HTIME 1X 13HLOWER CORRIDR 1X 5HRV-DE
     12A4, 1X 13HUPPER CORRIDR 1X 13HINTEGRL VALUE1X 13HLEAVE CORRIDR
     2 1X 13HENTER CORRIDR 5X 5HSLOPE)
 1100 FORMAT(1H F14.1,6F14.2)
 1200 FORMAT(1H 1P6E15.7,15X,E15.7)
 1900 FORMAT(1H0 2A4,  1X 11HINTEGRAL =  1PE15.7,1X17HLEAVE CORRIDOR AT
     1 E15.7)
 1800 FORMAT(1H0 13HINTEGRAL OF (2A4,10H/SIGMA)**2  1PE15.7)
      END
```

```
CJNXBES
          IMPLICIT REAL *8 (A-H, O-P )
          IMPLICIT REAL *8 (R-Z )
          IMPLICIT COMPLEX * 16 ( Q )
         SUBROUTINE JNXBES(ZR,ZI, NN, C, ZNR, ZNI )
           DIMENSION SR(2), SI(2) , TEMP(2)
C
C
C            SUBROUTINE JNXBES IS CALLED BY BESSEL TO CALCULATE THE BESSEL
C          FUNCTIONS OF MAXIMUM ORDER, N, AND OF N-1.
C
          QX= DCMPLX(ZR,ZI)
            Z=CDABS(QX)
          QXXI=(0.0D0,0.0D0)
          QXNU=(0.0D0,0.0D0)
C
                     IF( Z- 19.9999999999       )10,11,11
C
   11     QXI = (1.D0, 0.D0)
C FORMULA 9.2.5 HANDBOOK OF MATH FUNCTIONS-U.S. DEPT. COMMERCE
            QCC= DCMPLX(C, 0.D0)
           QX8= (8.D0,0.D0) * QX
         QPI =(3.14159265358979 , 0.D0 )
          QXNU=DFLOAT(NN)
          QCHI = QX -( (0.5D0,0.D0)* QXNU &(.25D0,0.D0) )* QPI
          QXMU = (4.D0,0.D0) * QXNU * QXNU
          QP = (1.D0,0.D0)
          QQ=(QXMU -(1.D0,0.D0)) / QX8
          QZ8 =QX8 ** 2
          QPT = QP
C
           DO  12  I=2,  4000 , 2
          QXXI=DFLOAT(I*(I-1))
          QPT = -QPT * ( QXMU - QXI * QXI) * (QXMU -( QXI &(2.D0,0.D0) )
      1**2 ) / QXXI  / QZ8
           QPNEW  = QP &  QPT
          RTPN =  CDABS(QPT/QPNEW)
          IF(  RTPN -C ) 13, 14, 14
   14     CONTINUE
           QP = QPNEW
   12     QXI = QXI  &(4.D0, 0.D0)
   13   CONTINUE
C
          QXI = (3.D0,0.D0)
          QQT = QQ
           DO 15  I=3,4000, 2
          QXXI=DFLOAT(I*(I-1))
          QQT = -QQT * (QXMU -QXI * QXI ) * (QXMU -(QXI &(2.D0,0.D0) )**2
      1 )/QXXI /QZ8
          QQNEW = QQ & QQT
           RQTQN = CDABS( QQT /QQNEW )
           IF( RQTQN - C ) 16, 17, 17
   17     CONTINUE
          QQ = QQNEW
   15     QXI = QXI & (4.D0,0.D0)
   16     CONTINUE
C
          QANS = CDSQRT( (2.D0,0.D0)/ QPI /QX ) * (QPNEW * CDCOS(QCHI)
      1-QQNEW * CDSIN(QCHI))
```

```
      CALL DRLIM( QANS , TEMP )
      ZNR = TEMP(1)
      ZNI = TEMP(2)
      RETURN
C
 10   CONTINUE
      A=1.D0
      DO 1 I=1,NN
    1 A=DFLOAT(I) *A
      Z2R=ZR / 2.D0
      Z2I=ZI / 2.D0
      R=SQRT(Z2R**2&Z2I**2)
      THET=ATAN2(Z2I,Z2R)
      SUMR=1.D0
      SUMI=0.D00
         ANG= DFLOAT(NN)          *THET
      RNNA=R**NN /A
      X2NR=COS(ANG)*RNNA
      X2NI=SIN(ANG)*RNNA
      DIV=1.D0
        SR(1) = 1.065
        SR(2) = 1.065
C
      DO 5 I=1,32000
      IF (MOD(I,2))2,3,2
    3 M=1
      GO TO 4
    2 M=2
    4 K=2*I
          AI=DFLOAT( K)* THET
      DIV=-( DIV*R/DFLOAT(I) )*R /DFLOAT(NN&I)
      SR(M)=DIV*COS(AI)
      SI(M)=DIV*SIN(AI)
      SUMR=SUMR&SR(M)
      SUMI=SUMI&SI(M)
      IF (ABS(SR(2)-SR(1))-C)6,5,5
    6 IF (ABS(SI(2)-SI(1))-C)7,5,5
    5 CONTINUE
C
      WRITE(6,1000)
 1000 FORMAT (52H  SERIES NOT CONVERGED IN 32000 ATTEMPTS FOR JNXBES.)
    7 ZNR=X2NR*SUMR-X2NI*SUMI
      ZNI=X2NR*SUMI&X2NI*SUMR
      RETURN
      END
```

```
CLINFIT
      IMPLICIT REAL*8(A-H,O-Z)
      SUBROUTINE LINFIT(ND,NENTRY,X,Y,A,B)
      DIMENSION X(ND), Y(ND), A(ND), B(ND)
C
C
C         GIVEN THE NENTRY POINTS (X,Y), SUBROUTINE LINFIT FINDS THE
C        EQUATION OF THE LINE PASSING THROUGH THE POINTS (X,Y) AND
C        ( X(I),Y(I) ) IN THE FORM Y=A(I)*X&B(I) FOR I=1,2,...,NENTRY-1.
C        THESE COEFFICIENTS CAN THEN BE USED BY THE CALLING PROGRAM
C        FOR MAKING A LINEAR FIT WHEN THE INTERVAL REQUIRED IS KNOWN
C        IN ADVANCE.
C
C
      N = NENTRY -1
      DO 77 J = 1, N
      A(J) = (Y(J&1)-Y(J))/(X(J&1)-X(J))
      B(J) = Y(J) -A(J)*X(J)
77    CONTINUE
1111  RETURN
      END
```

```
CLNTERP
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE LNTERP(TBATMZ,TABRHO,TABSND,UPBNDZ,DNBNDZ,Z,RHO,ASOUND)
C
        DIMENSION  TBATMZ(1),TABRHO(1),TABSND(1)
C
C         SUBROUTINE LNTERP DOES A LOGARITHMIC INTERPOLATION TO OBTAIN
C       FREE STREAM DENSITY AND A LINEAR INTERPOLATION TO OBTAIN FREE
C       STREAM SOUND SPEED FROM THE INPUT TABLES WHEN Z IS LESS THAN OR
C       EQUAL TO UPBNDZ AND GREATER THAN DNBNDZ.
C
C     TABLES MUST BE INPUT WITH LOWEST VALUE OF ALTITUDE FIRST
C     TABRHO IS IN LBM/FT**3   TABSND IS IN FT/SEC   TBATMZ IN FEET
C     IF Z IS LESS THAN UPBNDZ AND GREATER THAN DNBNDZ USE TABLES INPUT
C
      IF(Z-UPBNDZ)10,40,30
   10 IF(Z-DNBNDZ)30,30,40
   40 DO 45 I=1,50
      J=I
      IF(TBATMZ(I)-Z)45,46,46
   45 CONTINUE
      CALL EXIT
C
   46 EX=(Z-TBATMZ(J-1))/(TBATMZ(J)-TBATMZ(J-1))
      RHO=(TABRHO(J-1)*(TABRHO(J)/TABRHO(J-1))**EX)/32.174
      RATIO=(TABSND(J)-TABSND(J-1))/(TBATMZ(J)-TBATMZ(J-1))
      ASOUND=TABSND(J-1)&(Z-TBATMZ(J-1))*RATIO
C     RHO IS IN SLUG/FT**3   ASOUND IS IN FT/SEC
      GO TO 50
C
   30 CALL ARPDT2(Z,ASOUND,RHO)
   50 RETURN
      END
```

```
CMASSLO
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE MASSLO
C
      REAL*8 LAMDA
C
      DIMENSION OCCUR(4000),NOCCUR(30),TW(4,8),SDOT(4,8)
     1,QDOT(4,8)
C
      EQUIVALENCE
     1(OCCUR(032),LAMDA ),(OCCUR(068),SPD    ),(OCCUR(073),TWSTAG),
     2(OCCUR(091),Z      ),(OCCUR(092),ZTR    ),(OCCUR(115),C      ),
     3(OCCUR(2644),TW(1,1)  ),(OCCUR(2676),QDOT(1,1)),
     4(OCCUR(2740),SDOT(1,1))
      EQUIVALENCE
     1(NOCCUR(01),JJHOLD),(NOCCUR(02),KKHOLD)
C
      COMMON OCCUR,NOCCUR
C
C
C
C         SUBROUTINE MASSLO CONTROLS THE CALLING OF SUBROUTINE EVIL.
C       MASSLO CALLS IN EVIL FOR EACH BODY STATION FOR WHICH MASS LOSS
C       CALCULATIONS ARE REQUIRED.
C
C     J=1  STAG
C     J=2   LAM
C     J=3   TURB
C     J=4    SONIC
C
C         STAGNATION POINT CALCULATIONS.
      J=1
      K=1
      ASSIGN 2 TO NEXT
      QDOT(1,1)=QDOT(1,1)*C
      GO TO 100
    2 TWSTAG=TW(1,1)
      QDOT(1,1)=QDOT(1,1)/C
      IF(Z.LT.ZTR)GO TO 3
      IF(LAMDA.GT.1.0D-3)GO TO 4
C
C         LAMINAR FLOW, SHARP CONE AT MAXIMUM DIAMETER .
      J=2
      K=8
      ASSIGN 200 TO NEXT
      GO TO 100
C
C         LAMINAR FLOW, BLUNT CONE CALCULATIONS.
    4 J=2
      K=0
   20 K=K+1
      IF(K.EQ.9)GO  TO 200
      ASSIGN 20 TO NEXT
      GO TO 100
C
    3 IF(LAMDA.GT.1.0D-3)GO TO 5
C
C         TURBULENT FLOW, CALCULATIONS AT MAX. DIAMETER POINT OF A
C       SHARP CONE.
```

```
      J=7
      K=9
      ASSIGN 200 TO NEXT
      GO TO 100
C
C           TURBULENT FLOW, BLUNT CONE CALCULATIONS.
C           SONIC POINT TURBULENT CALCULATIONS.
    5 J=4
      K=1
      ASSIGN 6 TO NEXT
      GO TO 100
C           TANGENT POINT AND CONICAL FRUSTUM POINTS TURBULENT FLOW.
    6 J=3
      K=0
   30 K=K+1
      IF(K.EQ.9)GO TO 200
      ASSIGN 30 TO NEXT
      GO TO 100
  200 RETURN
C
C           CALLING IN SUBROUTINE EVIL TO PERFORM MASS LOSS RATE
C         CALCULATION.
  100 JJHOLD=J
      KKHOLD=K
      CALL EVIL(ZZ)
      TW(J,K)=ZZ
      SDOT(J,K)=SPD
C
      GO TO NEXT,(2,200,20,6,30)
      END
```

```
CMATM
         IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE MATMP (M,N,H,G,S)
      DIMENSION G(40),S(40)
      DIMENSION H(40,40)
C     MATRIX MULTIPLICATION
C
C
C             SUBROUTINE MATMP MULTIPLIES THE VECTOR G ON THE LEFT BY THE
C          MATRIX H TO PRODUCE A NEW VECTOR S.
C
C
  702 DO 703 I=1,M
  700 S(I)=0.0
      DO 703 J=1,N
  703 S(I)=H(J,I)*G(J)&S(I)
  704 RETURN
      END
```

```
CMATMPY
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE MATMPY(A,B,C)
      DIMENSION A(3),B(3,3),C(3)
C
C          SUBROUTINE MATMPY MULTIPLIES A THREE BY THREE MATRIX BY A
C        COLUMN MATRIX HAVING THREE COMPONENTS.
C
      DO 1 I=1,3
      A(I)=0.0D0
      DO 1 J=1,3
    1 A(I)=A(I)&B(I,J)*C(J)
      RETURN
      END
```

```
CMAXMIN
      IMPLICIT REAL *8(A-H,O-Z)
      SUBROUTINE MAXMIN(NTABLE,NDIMEN,X,XMIN,XMAX)
      DIMENSION X(NDIMEN)
C
C         SUBROUTINE MAXMIN FINDS THE LARGEST AND SMALLEST VALUES IN
C       THE   ARRAY, WHICH CONTAINS NTABLE NUMBERS.  THE SMALLEST VALUE
C       IS PLACED IN LOCATION XMIN AND THE LARGEST IN LOCATION XMAX.
C
C
      IF(NDIMEN.GE.NTABLE) GO TO 20
      WRITE(6,10) NDIMEN, NTABLE
      CALL EXIT
20    XMIN = X(1)
      XMAX = X(1)
      IF(NTABLE.EQ.1) RETURN
C
      DO 77 J = 2, NTABLE
      IF(X(J).LT.XMIN) XMIN = X(J)
      IF(X(J).GT.XMAX) XMAX = X(J)
77    CONTINUE
C
1111  RETURN
10    FORMAT(1H112HDIMENSION IS I12, 1X 13HTABLE SIZE IS I12/1H 4HEXIT)
      END
```

```
CMIMAX
        IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE MIMAX (AA,BB,NF,NMIMAX,ACCUR,NFUNC,XMIMAX,YMIMAX)
      IW=6
      DIMENSION E(100)
      COMMON /END/ ITERM
C
C
C           SUBROUTINE MIMAX UTILIZES A FIBCNACCI SEARCH TECHNIQUE TO
C         FIND THE MAXIMUM OR MINIMUM OF A ONE VARIABLE UNIMODAL
C         FUNCTION WITHIN A DEFINED REGION (AA,BB).
C
C
      A=AA
      B=BB
      IF (NMIMAX) 10,11,11
   10 JMIMAX=1
      GO TO 20
   11 JMIMAX=2
   20 IF (B-A) 21,22,23
   21 TEMP=A
      A=B
      B=TEMP
      GO TO 23
   22 L=1
C
   25 WRITE (IW,26)  L
   26 FORMAT(17H0  ERROR OF TYPE  I2)
      ITERM = 1
      GO TO 170
   23 R=B-A
      IF (NFUNC) 31,30,35
   30 IF (ACCUR) 31,31,40
   31 L=2
      GO TO 25
   35 NFUNC2=NFUNC&2
      R1=(1.0D0&SQRT (5.0D0))/2.0D0
      R2=(1.0D0-SQRT (5.0D0))/2.0D0
      ROACC=(R1**NFUNC2-R2**NFUNC2)/(R1-R2)
      GO TO 45
   40 ROACC=R/ACCUR
C
   45 IF (ROACC-2.0D0) 50,50,51
   50 XMIMAX=(A&B)/2.0D0
      YMIMAX=FMIMAX(XMIMAX,NF)
      GO TO 170
C
C
C
   51 IF (ROACC-3.0D0) 60,60,61
   60 XL=A&(B-A)/3.0D0
      XR=A&2.0D0*(B-A)/3.0D0
      YL=FMIMAX(XL,NF)
      IF(ITERM.NE.0) GO TO 160
      YR=FMIMAX(XR,NF)
      IF(ITERM.NE.0) GO TO 150
      IF(YL-YR) 70,70,71
   70 XMIMAX=XR
      YMIMAX=YR
```

```
      GO TO 170                                                         MIMAX 60
   71 XMIMAX=XL                                                         MIMAX 61
      YMIMAX=YL                                                         MIMAX 62
      GO TO 170                                                         MIMAX 63
C                                                                       MIMAX 64
C                                                                       MIMAX 65
C                                                                       MIMAX 66
   61 K=3                                                               MIMAX 67
      E(1) = 1.0D0                                                      MIMAX 68
      E(2)=1.0D0                                                        MIMAX 69
C                                                                       MIMAX 70
   74 E(K)=E(K-1)&E(K-2)                                                MIMAX 71
      IF (ROACC-E(K)) 80,80,75                                          MIMAX 72
   75 IF (K-40) 77,76,76                                                MIMAX 73
   76 L=3                                                               MIMAX 74
      GO TO 25                                                          MIMAX 75
   77 K=K&1                                                             MIMAX 76
      GO TO 74                                                          MIMAX 77
   80 N=K                                                               MIMAX 78
      XL=A&E(N-2)*R/E(N)                                                MIMAX 79
      XR=A&E(N-1)*R/E(N)                                                MIMAX 80
      YL=FMIMAX(XL,NF)                                                  MIMAX 81
      IF(ITERM.NE.0) GO TO 160                                          MIMAX 82
      YR=FMIMAX(XR,NF)                                                  MIMAX 83
      IF(ITERM.NE.0) GO TO 150                                          MIMAX 84
      J=1                                                               MIMAX 85
C                                                                       MIMAX 86
   90 NJ=N-J                                                            MIMAX 87
      NJONE=N-J-1                                                       MIMAX 88
      NJTWO=N-J-2                                                       MIMAX 89
      GO TO (100,101), JMIMAX                                           MIMAX 90
  100 IF (YR-YL) 130,130,110                                            MIMAX 91
  101 IF (YR-YL) 110,110,130                                            MIMAX 92
  110 IF (J-N&3) 120,160,160                                            MIMAX 93
  120 B=XR                                                              MIMAX 94
      A=A                                                               MIMAX 95
      R=B-A                                                             MIMAX 96
      XR=XL                                                             MIMAX 97
      XL=A&E(NJTWO)*R/E(NJ)                                             MIMAX 98
      YR=YL                                                             MIMAX 99
      YL=FMIMAX(XL,NF)                                                  MIMAX100
      IF(ITERM.NE.0) GO TO 160                                          MIMAX101
  125 J=J&1                                                             MIMAX102
      GO TO 90                                                          MIMAX103
C                                                                       MIMAX104
  130 IF (J-N&3) 140,150,150                                            MIMAX105
  140 B=B                                                               MIMAX106
      A=XL                                                              MIMAX107
      R=B-A                                                             MIMAX108
      XL=XR                                                             MIMAX109
      XR=A&E(NJONE)*R/E(NJ)                                             MIMAX110
      YL=YR                                                             MIMAX111
      YR=FMIMAX(XR,NF)                                                  MIMAX112
      IF(ITERM.NE.0) GO TO 150                                          MIMAX113
      GO TO 125                                                         MIMAX114
C                                                                       MIMAX115
  150 XMIMAX=XR                                                         MIMAX116
      YMIMAX=YR                                                         MIMAX117
      GO TO 170                                                         MIMAX118
  160 XMIMAX=XL                                                         MIMAX119
```

```
      YMIMAX=YL                                                  MIMAX120
  170 RETURN                                                     MIMAX121
      END                                                        MIMAX122
```

```
CMISC---------------------------------------------------------------------
      SUBROUTINE MISC(N,X,VAL)
      IMPLICIT REAL*8(A-H,O-Z)
      REAL*8 LA1,LA2,LA1F,LAMDA1,LAMDA2,LAMD1F
      COMMON OCCUR, NOCCUR
      COMMON /IGDHL/ IGDL(20), IGDH(20)
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      COMMON /CPCCUR/ PCCUR(11770)
      DIMENSION ACOE(140)
      DIMENSION DIF(6),NOCCUR(30), OCCUR(4000),RATIO(8),X(20)
      DIMENSION GD(20)
      EQUIVALENCE (PCCUR(05881), ACOE  )
      EQUIVALENCE (OCCUR(03964), DELRCS)
      EQUIVALENCE(OCCUR(170),W1F),(OCCUR(150),THET1F),(OCCUR(169),RN1F),
     1(OCCUR(147),RB1F),(OCCUR(151),LAMD1F),(OCCUR(146),LA1F)
      EQUIVALENCE
     1(OCCUR(133),W1    ),(OCCUR(134),THETA1),(OCCUR(135),RN1    ),
     2(OCCUR(136),RB1   ),(OCCUR(137),LAMDA1),(OCCUR(138),LA1    ),
     3(OCCUR(139),W2    ),(OCCUR(140),THETA2),(OCCUR(141),RN2    ),
     4(OCCUR(142),RB2   ),(OCCUR(143),LAMDA2),(OCCUR(144),LA2    ),
     5(OCCUR(145),ZTURN)
      EQUIVALENCE (OCCUR(42),PI)
      EQUIVALENCE (OCCUR(3921), GD(1))
C
C-------------------------------------------------------------------------
C          AT PRESENT SUBROUTINE MISC CAN CALL SUBROUTINE POLCAL TO
C       CALCULATE THE FREE SPACE RADAR CROSS SECTION OF A VEHICLE.
C       HOWEVER, THE FIRST THREE ARGUMENTS OF POLCAL HAVE BEEN GENERAL-
C       IZED SO THAT ANY THREE ELEMENTS OF THE OCCUR ARRAY CAN BE USED.
C       IT CALCULATES THE ELEMENTS OF THE GD ARRAY OF GENERALIZED
C       DIFFERENCES BETWEEN UP TO TWENTY PAIRS OF ELEMENTS OF THE
C       OCCUR ARRAY.  MISC IS INTENDED, IN GENERAL, TO PERFORM ANY
C       TASKS WHICH DO NOT SEEM TO FIT READILY INTO ANY OF THE OTHER
C       SUBROUTINES.
C-------------------------------------------------------------------------
C
      IF(ICOM(7)*ICOM(8)*ICOM(9).NE.0) GO TO 30
      ANS = 0.D0
      GO TO 40
C
C-------------------------------------------------------------------------
   30 ID = ICOM(7)
      DV1 = OCCUR(ID)
      ID = ICOM(8)
      DV2 = OCCUR(ID)
      ID = ICOM(9)
      DV3 = OCCUR(ID)
      CALL POLCAL(DV1,DV2,DV3,ICOM(4),ICOM(5),ICOM(6),2,ACOE,ANS)
   40 DELRCS = XCOM(7)-ANS*XCOM(8)
C
C-------------------------------------------------------------------------
      DO 111 J = 1, 20
      IF(IGDH(J).EQ.0.OR.IGDL(J).EQ.0)  GO TO 112
      GD(J) = OCCUR(IGDH(J)) -OCCUR(IGDL(J))
  111 CONTINUE
  112 CONTINUE
C
C
C
```

```
      DO 11 I = 1, 8
      IF(I.GT.6) GO TO 11
      DIF(I) = 0.D0
11    RATIO(I) = 0.D0
      TR = .174532930-1*THETA1
      R = RN1*DCOS(TR)
      H = RN1*(1.D0-DSIN(TR))
      V1=PI*(H*H*(RN1-H/3.D0)&(LA1-H)*(RB1*(RB1&R)&R*R)/3.D0)
       RATIO(7) = W1 / V1
      IF(ZTURN.LE.0.D0) GO TO 200
      TR = .174532930-1*THETA2
      R = RN2*DCOS(TR)
      H = RN2*(1.D0-DSIN(TR))
      V2=PI*(H*H*(RN2-H/3.D0)&(LA2-H)*(RB2*(RB2&R)&R*R)/3.D0)
       RATIO(8) = W2 / V2
      DIF(1) = W2 -W1F
      DIF(2) = THETA2 -THET1F
      DIF(3) = RN2 -RN1F
      DIF(4) = RB2 -RB1F
      DIF(5) = LAMDA2 -LAMD1F
      DIF(6) = LA2 -LA1F
      RATIO(1) = W2/W1F
      RATIO(2) = THETA2/THET1F
      IF(RN1F.NE.0.D0) RATIO(3) = RN2/RN1F
      RATIO(4) = RB2/RB1F
      IF(LAMD1F.NE.0.D0) RATIO(5) = LAMDA2/LAMD1F
      RATIO(6) = LA2/LA1F
200   WRITE(6,1000) (RATIO(I),I=1,8),(DIF(I),I=1,6)
C
      DO 44 I = 1, 8
      IF(I.GT.6) GO TO 44
      OCCUR(I&3900) = DIF(I)
44    OCCUR(I&3906) = RATIO(I)
C
      RETURN
C
1000  FORMAT(1H0'MISC          W2/W1F          TH2/TH1F          RN2/RN1F
     1 RB2/RB1F          LM2/LM1F          LA2/LA1F          W1/V1          W2
     2/V2'/1H 4X 8F15.3/1H0'          W2-W1F          TH2-TH1F          R
     3N2-RN1F          RB2-RB1F          LM2-LM1F          LA2-LA1F'/1H 6F15.3)
      END
```

```
CNEUMAN                                                                 NEUMA
      IMPLICIT REAL*8(A-H,O-Z)                                          NEUMA
      SUBROUTINE NEUMAN(C,XR,XI,N,XL,ZZNR,                              NEUMA
     1ZZNI,XOR,XOI,X1R,X1I,IT)                                          NEUMA
      DIMENSION ZZNR(200,1),ZZNI(200,1)                                 NEUMA
C                                                                       NEUMA
C                                                                       NEUMA
C        SUBROUTINE NEUMAN CALCULATES FOR COMPLEX ARGUMENTS THE         NEUMA
C       NEUMANN FUNCTIONS OF INTEGRAL ORDER ZERO THROUGH TWENTY-FOUR.   NEUMA
C       FOR ARGUMENTS OF MAGNITUDE LESS THAN XL THE STANDARD POWER      NEUMA
C       SERIES IS USED TO CALCULATE THE NEUMANN FUNCTIONS OF ORDER ZERONEUMA
C       AND ONE.   NEUMAN CALLS IN NEUMNO AND NEUMN1 TO CALCULATE THE   NEUMA
C       POWER SERIES FOR THE ZEROTH AND FIRST ORDER FUNCTIONS, RESPEC-  NEUMA
C       TIVELY.   FOR ARGUMENTS GREATER THAN XL AN ASYMPTOTIC SERIES ISNEUMA
C       USED FOR ORDERS ZERO AND ONE.   NEUMAN CALLS IN NEUMPO AND      NEUMA
C       NEUMQO TO PERFORM THE CALCULATIONS USED IN OBTAINING THE ZEROTHNEUMA
C       ORDER FUNCTIONS AND DIVMLT CALCULATES THE FIRST ORDER FUNCTIONSNEUMA
C       BY ASYMPTOTIC SERIES.   A FORMULA IS THEN USED TO GENERATE EACHNEUMA
C       INCREASING ORDER UNTIL THE NTH ORDER IS DETERMINED.             NEUMA
C                                                                       NEUMA
C                                                                       NEUMA
      D=DSQRT(XR*XR+XI*XI)                                              NEUMA
      IF (D)8,10,8                                                      NEUMA
   10 ZZNR(1,IT)=0.0D0                                                  NEUMA
      ZZNI(1,IT)=0.0D0                                                  NEUMA
      ZZNR(2,IT)=0.0D0                                                  NEUMA
      ZZNI(2,IT)=0.0D0                                                  NEUMA
      GO TO 11                                                          NEUMA
    8 CONTINUE                                                          NEUMA
C                                                                       NEUMA
      IF (D-XL)1,1,2                                                    NEUMA
C                                                                       NEUMA
C          NEUMANN FUNCTION CALCULATIONS FOR LARGE X                    NEUMA
    2 CALL NEUMPO(XR,XI,C,PNR,PNI)                                      NEUMA
      CALL NEUMQO(XR,XI,C,QNR,QNI)                                      NEUMA
      THET=ATANOR(XI,XR)                                                NEUMA
      PI2RT=DSQRT(2.0D0/3.1415926D0)                                    NEUMA
      XRP=XR-0.785398200                                                NEUMA
      SINRP=DSIN(XRP)                                                   NEUMA
      COSRP=DCOS(XRP)                                                   NEUMA
      E=DEXP(XI)                                                        NEUMA
      COSHH=(E+1.0D0/E)/2.0D0                                           NEUMA
      SINHH=(E-1.0D0/E)/2.0D0                                           NEUMA
      COSR=COSRP*COSHH                                                  NEUMA
      COSI=-SINRP*SINHH                                                 NEUMA
      SINR=SINRP*COSHH                                                  NEUMA
      SINI=COSRP*SINHH                                                  NEUMA
      OR=XR/D**2                                                        NEUMA
      OI=-XI/D**2                                                       NEUMA
C                                                                       NEUMA
      IF (XI)6,5,6                                                      NEUMA
    5 XOR=DSQRT(OR)                                                     NEUMA
      XOI=0.0D0                                                         NEUMA
      GO TO 7                                                           NEUMA
    6 THTO=ATANOR(OI,OR)                                                NEUMA
      RO=DSQRT(DSQRT(OI*OI+OR*OR))                                      NEUMA
      XOR=-RO*DCOS(THTO/2.0D0)                                          NEUMA
      XOI=-RO*DSIN(THTO/2.0D0)                                          NEUMA
    7 ZNIKR=QNR*COSR-QNI*COSI+PNR*SINR-PNI*SINI                         NEUMA
      ZNINI=QNI*COSR+QNR*COSI+PNI*SINR+PNR*SINI                         NEUMA
```

```
      ZZNR(1,IT)=PI2RT*(XOR*ZNINR-XOI*ZNINI)
      ZZNI(1,IT)=PI2RT*(XOI*ZNINR+XOR*ZNINI)
      XUMR=ZZNR(1,IT)*X1R-ZZNI(1,IT)*X1I-2.0D0/3.1415926D0*OR
      XUMI=ZZNI(1,IT)*X1R+ZZNR(1,IT)*X1I-2.0D0/3.1415926D0*OI
      CALL DIVMLT(XUMR,XUMI,XOR,XOI,ZZNR(2,IT),ZZNI(2,IT))
      GO TO 3
C
C
C          NEUMANN FUNCTION CALCULATIONS FOR SMALL X
    1 CALL NEUMNO(XR,XI,XOR,XOI,ZZNR(1,IT),ZZNI(1,IT),C)
      CALL NEUMN1(XR,XI,X1R,X1I,ZZNR(2,IT),ZZNI(2,IT),C)
C
    3 B=XR**2+XI*XI
      XRB=XR/B
      XIB=-XI/B
   11 NN=N+1
      DO 4 I=3,NN
      XNN=DFLOAT(I-2)
      IM2=I-2
      IM=I-1
      ZZNR(I,IT)=2.0D0*XNN*(ZZNR(IM,IT)*XRB-ZZNI(IM,IT)*XIB)-ZZNR(IM2,
     1IT)
    4 ZZNI(I,IT)=2.0D0*XNN*(ZZNR(IM,IT)*XIB+ZZNI(IM,IT)*XRB)-ZZNI(IM2,
     2IT)
      RETURN
      END
```

NOT REPRODUCIBLE

```
CNEUMP
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE NEUMPO(XR,XI,C,PNR,PNI)
      DIMENSION SR(2),SI(2)
C
C           SUBROUTINE NEUMPO CALCULATES THE REAL AND IMAGINARY COMPO-
C        NENTS OF THE P-COMPONENT OF THE ZEROTH ORDER NEUMANN FUNCTION
C        N(P,Q).
C
      LTAP5=6
      D=XR**2&XI**2
      RR=1.D0/D
      RI=-2.D0*XR*XI/D**2
      SR(1)=1.0D0
      SI(1)=0.0D0
      SR(2)=1.D65
      PNR=0.0D0
      PNI=0.0D0
C
      DO 1 I=1,32000
      IF (MOD(I,2))3,2,3
    2 MM=1
      M=2
      GO TO 4
    3 MM=2
      M=1
C
    4 PNR=PNR&SR(M)
      PNI=PNI&SI(M)
      IF(DABS(SR(1)-SR(2))-C)5,5,6
5     IF(DABS(SI(1)-SI(2))-C)7,7,6
6     XH=DFLOAT(2*I)
      XT=2.D0*XB-1.D0
      XMULT=-1.D0/(XB-1.D0)*(XT-2.D0)**2/XB*XT*XT/64.D0
      SR(MM)=XMULT*(SR(M)*RR-SI(M)*RI)
    1 SI(MM)=XMULT*(SR(M)*RI&SI(M)*RR)
      WRITE (LTAP5,1000)
 1000 FORMAT (47H  SERIES NOT CONVERGED IN 32000 ATTEMPTS FOR PO)
C
    7 CONTINUE
      RETURN
      END
```

```
CNEUMQ
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE NEUMQO(XR,XI,C,QNR,QNI)
      DIMENSION SR(2),SI(2)
C
C        SUBROUTINE NEUMQO CALCULATES THE REAL AND IMAGINARY COMPO-
C     NENTS OF THE Q COMPONENT OF THE ZEROTH ORDER NEUMANN FUNCTION
C        N(P,Q).
C
      LTAP5=6
      D=XR**2&XI**2
      TNR=XR/D
      TNI=-XI/D
      RR=1.D0/D
      RI=-2.D0*XR*XI/D**2
      SR(2)=1.D65
      QNR=0.0D0
      QNI=0.0D0
      SR(1)=-.125D0*TNR
      SI(1)=-.125D0*TNI
C
      DO 1 I=1,32000
      IF (MOD(I,2))3,2,3
    2 MM=1
      M=2
      GO TO 4
    3 MM=2
      M=1
C
    4 QNR=QNR&SR(M)
      QNI=QNI&SI(M)
      IF(DABS(SR(1)-SR(2))-C)5,5,6
5     IF(DABS(SI(1)-SI(2))-C)7,7,6
6     XB=DFLOAT(2*I)
      XT=2.D0*XB&1.D0
      XMULT=-1.D0/XB*XT**2/(XB&1.D0)*(XT-2.D0)**2/64.D0
      SR(MM)=XMULT*(SR(M)*RR-SI(M)*RI)
    1 SI(MM)=XMULT*(SR(M)*RI&SI(M)*RR)
      WRITE (LTAP5,1000)
 1000 FORMAT (47H  SERIES NOT CONVERGED IN 32000 ATTEMPTS FOR Q0)
C
    7 CONTINUE
      RETURN
      END
```

```
CNEUMO
      IMPLICIT REAL*8 (A-H,O-Z)
     SUBROUTINE NEUMNO(ZR,ZI,XR,XI,ZNR,ZNI,
    1C)
     DIMENSION SR(2),SI(2)
C
C         SUBROUTINE NEUMNO CALCULATES THE REAL AND IMAGINARY COMPO-
C       NENTS OF THE 0TH ORDER NEUMANN FUNCTION FROM THE STANDARD POWER
C       SERIES.
C
      LTAP5=6
          DATA  PI/3.141592653589793/
      R=DSQRT(ZR**2+ZI**2)/2.D0
      RLG=DLOG(R)
      THET=ATANOR(ZI,ZR)
      ZNR=(.57721566000+RLG)*XR-THET*XI
      ZNI=(.57721566000+RLG)*XI+THET*XR
      FACT=1.D0
      T=1.D0
      SR(1)=1.D65
      SI(1)=SR(1)
C
      DO 1 I=1,32000
      IF (MOD(I,2))2,3,2
    3 M=1
      GO TO 4
    2 M=2
    4 SUM=(-1.D0)**M*T
      XK=I
      XN=XK*THET*2.D0
      TEMP=R**XK
      SR(M)=SUM*(TEMP/FACT)**2*DCOS(XN)
      SI(M)=SUM*(TEMP/FACT)**2*DSIN(XN)
      ZNR=ZNR+SR(M)
      ZNI=ZNI+SI(M)
      IF(DABS(SR(2)-SR(1))-C)5,6,6
    5 IF(DABS(SI(2)-SI(1))-C)7,6,6
    6 XXI=DFLOAT(I+1)
      FACT=FACT*XXI
    1 T=T+1.D0/XXI
C
    7 ZNR=ZNR*2.D0/PI
      ZNI=ZNI*2.D0/PI
      RETURN
      END
```

```
CNEUM1
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE NEUMN1(ZR,ZI,XR,XI,ZNR,ZNI,
     1C)
      DIMENSION SR(2),SI(2)
C
C        SUBROUTINE NEUMN1 CALCULATES THE REAL AND IMAGINARY COMPO-
C     NENTS OF THE 1ST ORDER NEUMANN FUNCTION FROM THE STANDARD POWER
C     SERIES.
C
         DATA  PI/3.141592653589793/
      R=DSQRT(ZR**2+ZI**2)/2.D0
      RLG=DLOG(R)
      THET=ATANOR(ZI,ZR)
      ZNR=2.0D0*(.5772156660D0+RLG)*XR-2.0D0*THET*XI
      ZNI=2.0D0*(.5772156660D0+RLG)*XI+2.0D0*THET*XR
      B=ZR**2+ZI**2
      XNB=ZR/B
      XIB=ZI/(-B)
      ZNR=ZNR-XNB*2.D0
      ZNI=ZNI-XIB*2.D0
      FACT2=2.D0
      FACT=1.D0
      SR(1)=1.D65
      SI(1)=SR(1)
      SERS=1.0D0
C
      DO 1 I=1,32000
      IF (MOD(I,2))2,3,2
    3 M=1
      GO TO 4
    2 M=2
    4 P1=DFLOAT(I)
      SUM=(-1.D0)**M/FACT/P1*SERS
      XK=DFLOAT(2*I-1)
      XN=XK*THET
      SR(M)=SUM*R**XK*DCOS(XN)/FACT
      SI(M)=SUM*R**XK*DSIN(XN)/FACT
      ZNR=ZNR+SR(M)
      ZNI=ZNI+SI(M)
      IF (DABS(SR(2)-SR(1))-C)5,6,6
    5 IF (DABS(SI(2)-SI(1))-C)7,6,6
    6 FACT=FACT*P1
    1 SERS=SERS+1.D0/P1+1.D0/(P1+1.D0)
C
    7 ZNR=ZNR/PI
      ZNI=ZNI/PI
      RETURN
      END
```

```
CNOSEBL
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE NOSEBL
C
      REAL*8 LAMDA
C
      DIMENSION SDOT(4,8),OCCUR(4000),NOCCUR(30)
C
      EQUIVALENCE
     1(OCCUR(008),COST  ),(OCCUR(032),LAMDA ),(OCCUR(059),RNDOT ),
     2(OCCUR(060),RBDOT ),(OCCUR(064),SINT  ),
     3(OCCUR(090),XBAR  ),(OCCUR(091),Z     ),(OCCUR(092),ZTR   ),
     4(OCCUR(237),XUP   ),(OCCUR(2740),SDOT(1,1))
C
      COMMON OCCUR,NOCCUR
C
C
C
C          SUBROUTINE NOSEBL OBTAINS DERIVATIVES OF NOSE RADIUS AND BASE
C        RADIUS WITH TIME IN ORDER TO CALCULATE SHAPE CHANGE FOR
C        CONSTANT CONE HALF ANGLE IN CONTINUUM FLOW.  IN RAREFIED FLOW,
C        THE DERIVATIVES ARE SET EQUAL TO ZERO.
C
C          RNDOT IS CALCULATED FROM STAG. POINT RECESSION RATE.
    1 IF(XBAR.GT.XUP)GO TO 2
      RNDOT=SDOT(1,1)*SINT/(1.D0-SINT)
C
C          BLUNTNESS RATIO LESS THAN OR = 1.0D-3 IS TREATED AS A SHARP
C        CONE AND SHARP CONE SIDEWALL RECESSION RATES ARE USED.
C        BLUNTNESS RATIO GREATER THAN 1.0D-3 USES BLUNT CONE SIDEWALL
C        RECESSION RATES.
      IF(LAMDA.GT.1.0D-3)GO TO 3
C
C          SHARP CONE SIDEWALL RECESSION RATE FACTORS.
C          TURBULENT
      IF(Z.LT.ZTR)TEM=0.5706D0*SDOT(3,8)
C          LAMINAR
      IF(Z.GE.ZTR)TEM=0.7071D0*SDOT(2,8)
      GO TO 4
C
C          BLUNT CONE SIDEWALL RECESSION RATE FACTORS
C          TURBULENT
    3 IF(Z.LT.ZTR)TEM=SDOT(3,7)
C          LAMINAR
      IF(Z.GE.ZTR)TEM=SDOT(2,7)
C
C          RATE OF CHANGE OF THE BASE
    4 RBDOT=-TEM/COST
      RETURN
C
C          DERIVATIVES ARE ZERO IN NON-CONTINUUM FLOW
    2 RNDOT=0.D0
      RBDOT=0.D0
      RETURN
      END
```

```
CPLT
      SUBROUTINE PLT
C
C        SUBROUTINE PLT IS A DUMMY SUBROUTINE INCLUDED SO THAT CALLS
C       TO THE AEROSPACE PLOTTER CAN BE SIMULATED.
C
      RETURN
      END
```

```
CPOLCAL
      SUBROUTINE POLCAL(X,Y,Z,NAX,NAY,NAZ,ITP,ACOE,ANS)
      IMPLICIT REAL*8 (A-H, O-Z)
      DIMENSION ACOE(140)
C
C
C         SUBROUTINE POLCAL EVALUATES THE POLYNOMIAL DEFINED BY THE
C            TRIPLE SUMMATION ( I FROM 1 TO NAX, J FROM 1 TO NAY, K FROM 1
C            TO NAZ ) OF THE EXPRESSION  -  ( A(NAX*NAY*(K-1)&NAX*(J-1)&I)
C            *X**(I-1) *Y**(J-1) *Z**(K-1)  ).
C
C
      M=0
      ANS=0.0D0
      IF(ITP-1) 20,20,10
   10 NAZU=NAZ
      GO TO 30
   20 NAZU=1
   30 DO 130 K=1,NAZU
      DO 130 J=1,NAY
      DO 130 I=1,NAX
      M=M&1
      IF(I-1) 40,40,50
   40 A=1.0D0
      GO TO 60
   50 A=X**(I-1)
   60 IF(J-1) 70,70,80
   70 B=1.0D0
      GO TO 90
   80 B=Y**(J-1)
   90 IF(K-1) 100,100,110
  100 C=1.0D0
      GO TO 120
  110 C=Z**(K-1)
C
  120 ANS=ANS & ACOE(M) * A * B * C
C
  130 CONTINUE
C
      RETURN
      END
```

```
CPRELI
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE PRELIM(LP)
C
      REAL*8 LAMDA,LA,MUINF,MINF,ME,M,MX,MY,MZ
      REAL*8 MINF2,MINF3,MLE,MUW
C
      DIMENSION  A(514),TXCGD(50),TABZ(50),TW(4,8),TBMAT(3),
     1           OCCUR(4000),NOCCUR(30),THDELZ(25),THTHO(25),THDELT(25)
      DIMENSION  TABRHO(50),TABSND(50),TBATMZ(50)
C
      EQUIVALENCE
     1(OCCUR(001),AREF  ),(OCCUR(008),COST  ),(OCCUR(009),CODRAG),
     2(OCCUR(010),CAPL  ),(OCCUR(011),COSLAM),(OCCUR(012),CNALP ),
     3(OCCUR(013),CMALP ),(OCCUR(017),CPF   ),(OCCUR(018),CPW   ),
     4(OCCUR(020),CMO   ),(OCCUR(021),D     ),(OCCUR(027),G     )
      EQUIVALENCE
     1(OCCUR(028),GAMMA ),(OCCUR(029),HSRT  ),(OCCUR(031),HS    ),
     2(OCCUR(032),LAMDA ),(OCCUR(033),LA    ),(OCCUR(034),MUINF ),
     3(OCCUR(035),MINF  ),(OCCUR(036),ME    ),(OCCUR(037),M     ),
     4(OCCUR(042),PT    ),(OCCUR(046),PINFPS),(OCCUR(047),PS    ),
     5(OCCUR(048),PE    ),(OCCUR(049),PINF  ),(OCCUR(051),QD    ),
     6(OCCUR(052),RN    ),(OCCUR(053),RB    ),(OCCUR(054),RESINT)
      EQUIVALENCE
     1(OCCUR(055),RHOINF),(OCCUR(056),RHOINL),(OCCUR(057),R     ),
     2(OCCUR(061),RHOE  ),(OCCUR(062),REYL  ),(OCCUR(064),SINT  ),
     3(OCCUR(066),SQCOST),(OCCUR(067),SINTM ),(OCCUR(069),THETAL),
     4(OCCUR(070),TANT  ),(OCCUR(072),TINF  ),(OCCUR(076),THETA ),
     5(OCCUR(079),TE    ),(OCCUR(080),TIMER )
      EQUIVALENCE
     1(OCCUR(082),V     ),(OCCUR(083),VE    ),(OCCUR(084),W     ),
     2(OCCUR(085),W     ),(OCCUR(088),XCPO  ),(OCCUR(089),XBARST),
     3(OCCUR(090),XBAR  ),(OCCUR(091),Z     ),(OCCUR(092),ZTR   ),
     4(OCCUR(094),CODLAM),(OCCUR(097),DELW  ),(OCCUR(176),XBAR1 ),
     5(OCCUR(196),CMOIN ),(OCCUR(198),S     ),(OCCUR(201),TH    )
      EQUIVALENCE
     1(OCCUR(204),WTH   ),(OCCUR(205),ZON   ),(OCCUR(206),ZOFF  ),
     2(OCCUR(207),THO   ),(OCCUR(208),TON   ),(OCCUR(209),TOFF  ),
     3(OCCUR(210),MX    ),(OCCUR(211),MY    ),(OCCUR(212),MZ    ),
     4(OCCUR(213),THINF ),(OCCUR(214),AE    ),(OCCUR(215),CTHZET),
     5(OCCUR(216),CPSZET),(OCCUR(217),STHZET),(OCCUR(218),SPSZET),
     6(OCCUR(219),DELY  ),(OCCUR(220),DELZ  ),(OCCUR(225),HWBAR)
      EQUIVALENCE
     1 (OCCUR(226),DELW2 ),(OCCUR(227),DELW3 ),(OCCUR(228),WTOTAL),
     2(OCCUR(243),TRZTR ),(OCCUR(244),REYINF),(OCCUR(245),PTOTAL),
     3(OCCUR(247),UPBNDZ),(OCCUR(248),DNBNDZ)
      EQUIVALENCE
     1(OCCUR(0301),     A(1)),(OCCUR(0844),TXCGD(1)),
     2(OCCUR(0994),  TABZ(1)),(OCCUR(2644),TW(1,1) ),
     3(OCCUR(3568), THTHO(1)),(OCCUR(3593),THDELZ(1)),
     4(OCCUR(3618),THDELT(1)),(OCCUR(3643), TBMAT(1))
      EQUIVALENCE
     1(OCCUR(3721), TBATMZ(1)),(OCCUR(3771), TABRHO(1)),
     2(OCCUR(3821),TABSND(1))
      EQUIVALENCE
     1(NOCCUR(04),MAXTAB),(NOCCUR(07),LOPT  ),(NOCCUR(08),IATMOS),
     2(NOCCUR(09),IKCMO ),(NOCCUR(14),NPRINT),(NOCCUR(22),NTHRST),
     3(NOCCUR(23),ITHRST)
C
```

```
      COMMON OCCUR,NOCCUR
C
C
C
C         SUBROUTINE PRELIM DOES PRELIMINARY CALCULATIONS OF GEOMETRIC,
C      FLOW FIELD, AND THRUSTING PARAMETERS.
C
C
C         GEOMETRIC PARAMETERS
C       CAPL=SHARP CONE SLANT LENGTH, LAMDA=BLUNTNESS RATIO, COSLAM=
C       COSINE OF THETA*LAMDA, LA=AXIAL LENGTH FROM STAGNATION POINT,
C       AREF=AREA OF THE BASE, D=BASE DIAMETER, S=SURFACE DISTANCE
C       FROM THE NOSE OF BLUNT CONE
C
      TEMTEM=32.20D0*2.27D-8
      CAPL=RB*RESINT
      LAMDA=RN/RB
      COSLAM=COST*LAMDA
      LA=CAPL*(COST-LAMDA*(1.D0-SINT))
      AREF=PI*RB*RB
      D=2.D0*RB
      S=RN*(0.5D0*PI-THETA)+RB*RESINT-RN/TANT
C
C          CALCULATIONS FOR AERO. COEFF. CN ALPHA,CMQ,CM ALPHA
C          XCGD AND XCPD ARE THE DISTANCES OF CENTER OF GRAVITY AND
C       CENTER OF PRESSURE FROM THE NOSE NON-DIMENSIONALIZED BY THE
C        BASE DIAMETER.
      CNALP=1.92*SQCOST*(1.D0-0.5D0*COSLAM**2)
      LL=-1
      XCG=D*TABLE(Z,TABZ,TXCGD,MAXTAB,LL)
      CMALP=-(2.D0*(1.D0-COSLAM**3)-3.D0*SQCOST*COSLAM*(1.D0-COSLAM**2))
     1/(3.D0*TANT)
      CMALP=CMALP-(RN-XCG)*SQCOST*(1.D0-0.5*COSLAM*COSLAM)/RB
      CMALP=CMALP+LAMDA*SINT*SQCOST*(1.D0-COSLAM*COSLAM)
      CMALP=0.96*CMALP
      IF(CMALP.GT.0.0D0)LP=6
      IF(CMALP.GT.0.0D0)WRITE(6,1000)
 1000 FORMAT(1H0 10X,20HCMALP GREATER THAN 0)
      IF(LP.EQ.6)RETURN
      XCPD=-CMALP/CNALP
      XCPD=XCPD+TABLE(Z,TABZ,TXCGD,MAXTAB,LL)
      TEM=COSLAM*SQCOST
      IF(IKCMQ.GT.0)GO TO 43
C
C         CALCULATED CMQ BEING USED
      CMQ=-TEM*(TEM*(1.D0-COSLAM**2)-4.D0*(1.D0-COSLAM**3)/3.D0)/(SINT**
     12)
      CMQ=CMQ-0.5D0*(1.D0-COSLAM**4)/(SINT*SINT)
      CMQ=CMQ-0.5D0*SQCOST*(COSLAM*(RN-XCG)/RB)**2
      TEM=XCG-RN*(1.D0-SINT)
      CMQ=CMQ+2.D0*TEM*(2.D0*(1.D0-COSLAM**3)-3.D0*SQCOST*COSLAM*(1.D0-
     1COSLAM*COSLAM))/(3.D0*RB*TANT)
      CMQ=CMQ-TEM*TEM*SQCOST*(1.D0-COSLAM**2)/(RB*RB)
      CMQ=0.96D0*CMQ
      GO TO 44
C
C          INPUT CMQ BEING USED
   43 CMQ=CMQIN
   44 CONTINUE
C
```

```
C         IF LOPT=4 THE FREE STREAM FLOW PARAMETERS ARE DETERMINED
C       FROM THE WIND TUNNEL INPUTS.
      IF(LOPT.EQ.4)GO TO 79
C
      IF(IATMOS.GT.0)GO TO 47
C
C         USING BUILT IN 1962 STANDARD ATMOSPHERE
      CALL ARFOT2(Z,ASOUND,RHO)
      GO TO 48
C
C         USING INPUT ATMOSPHERE FOR SPECIFIED RANGE OF ALTITUDE AND
C       THE 1962 STANDARD ATMOSPHERE OUTSIDE THIS RANGE.
   47 CONTINUE
      CALL INTERP(TBATMZ,TABRHO,TABSND,LPBNDZ,DNHNDZ,Z,RHO,ASOUND)
   48 CONTINUE
C
C         CALCULATION OF FREE STREAM CONDITIONS
C       REYLA=FREE STREAM REYNOLDS NUMBER BASED ON LA.  TINF IS IN
C       DEGREES RANKINE,  MUINF IS IN LBM/(FT-SEC),  RHOINF IS IN
C       SLUGS/FT**3,  RHOIN1 IS IN LBM/FT**3,  PINF IS IN LB/FT**2.
C       ALL LENGTHS ARE IN FEET
      AINF=ASOUND
      RHOINF=RHO
      RHOIN1=RHOINF*G
      CDDRAG=CODLAM/RHOIN1
      TINF=AINF*AINF*4.16D-4
      MUINF= TEMTEM*TINF**1.5D0/(TINF+198.6D0)
      REYLA=RHOIN1*V*LA/MUINF
      MINF=V/AINF
      MINF2=MINF*MINF
      MINF3=MINF2*MINF
      PINF=RHOIN1*R*TINF
      TINF=TINFR
      GO TO 89
C
C         CALCULATIONS OF FREE STREAM FLOW PROPERTIES FROM WIND TUNNEL
C       CONDITIONS INPUT.
C       REYINF IS THE REYNOLDS NUMBER PER INCH.  REYFT IS THE
C       REYNOLDS NUMBER PER FOOT.  PTOTAL IS IN LB/FT**2.
   79 CONTINUE
      MINF2=MINF*MINF
      MINF3=MINF2*MINF
      REYFT=REYINF*12.0
      PINF=PTOTAL/((1.0D0+(GAMMA-1.0D0)*MINF2/2.0D0)**(GAMMA/(GAMMA-1.0
     1D0)))
      TTK1=PINF*MINF/(2.0356D-02*R*TEMTEM)
      TTK2=198.6D0*TTK1
      T2TK1=TTK1*TTK1
      TTFACT=T2TK1+4.0D0*REYFT*TTK2
      IF(TTFACT.LT.0.0D0)GO TO 59
      TINF=(TTK1+DSQRT(TTFACT))/(2.0D0*REYFT)
      GO TO 57
   59 WRITE(6,1059)
 1059 FORMAT(10X,28HNEGATIVE SQUARE ROOT IN TINF)
      LP = 6
      RETURN
   57 CONTINUE
      RHOIN1=PINF/(R*TINF)
      RHOINF=RHOIN1/G
      AINF=DSQRT(TINF)/2.0356D-2
```

```
      MUINF=32.200*2.270-8*TINF**1.500/(TINF&198.600)
      V=MINF*AINF
C
   89 IF(LOPT.GE.3)GO TO 16
      IF(NTHRST.EQ.0) GO TO 16
C
C           THRUSTING OPTION CALCULATIONS
      GO TO (11,12),NTHRST
C
C           THRUST IS READ IN AS A FUNCTION OF ALTITUDE
   11 IF((Z-ZON).GT.1.D-4)GO TO 16
      IF(Z.LE.ZOFF)GO TO 13
      IF((Z-ZON).GE.0.0D0)KKTHR=0
      IF(KKTHR.EQ.0.AND.NPRINT.NE.0)WRITE(6,2222)Z
 2222 FORMAT(1H0,25X,'***THRUST TURNED ON AT Z=',E15.6,'***'/15X,'THIS M
     1ESSAGE IS VALID ONLY WHEN IT IS IMMEDIATELY BEFORE PRINTOUT'/)
      JJTHR=0
      KKTHR=KKTHR&1
      DELTAZ=ZON-Z
      LL=-1
      THINF=THO*TABLE(DELTAZ,THDELZ,THTHO,ITHRST,LL)
      GO TO 14
C
C           THRUST IS READ IN AS A FUNCTION OF TIME
   12 IF((TIME-TON).LT.1.D-4)GO TO 16
      IF(TIME.GE.TOFF)GO TO 13
      IF((TON-TIME).GE.0.0D0)KKTHR=0
      IF(KKTHR.EQ.0.AND.NPRINT.NE.0)WRITE(6,2223)TIME
 2223 FORMAT(1H0,25X,'***THRUST TURNED ON AT TIME=',F12.4,'***'/15X,'THI
     1S MESSAGE IS VALID ONLY WHEN IT IS IMMEDIATELY BEFORE PRINTOUT'/)
      JJTHR=0
      KKTHR=KKTHR&1
      DELTAT=TIME-TON
      LL=-1
      THINF=THO*TABLE(DELTAT,THDELT,THTHO,ITHRST,LL)
   14 TH=THINF-AE*PINF
      TBMAT(1)=TH*CTHZET*CPSZET
      TBMAT(2)=TH*CTHZET*SPSZET
      TBMAT(3)=-TH*STHZET
      RX=XCG-LA
      MX=DELY*TBMAT(3)-DELZ*TBMAT(2)
      MY=DELZ*TBMAT(1)-RX*TBMAT(3)
      MZ=RX*TBMAT(2)-DELY*TBMAT(1)
      GO TO 10
C
C           THRUST PARAMETERS ARE ZEROED OUT WHEN NOT BEING USED
   13 IF(JJTHR.NE.0)GO TO 16
      WRITE(6,2224)TIME,Z
 2224 FORMAT(1H0,25X,'***THRUST SHUT OFF AT TIME=',F12.4,' AND Z=',E15.6
     1,'***'/15X,'THIS MESSAGE IS VALID ONLY WHEN IT IS IMMEDIATELY BEFO
     2RE PRINTOUT'/)
      JJTHR=1
   16 MX = 0.0D0
      MY=0.0D0
      MZ=0.0D0
      TBMAT(1)=0.0D0
      TBMAT(2)=0.0D0
      TBMAT(3)=0.0D0
      TH=0.0D0
      THINF=0.0D0
```

NOT REPRODUCIBLE

```
      KKTHR=0
   10 CONTINUE
C
C         CALCULATIONS FOR SHARP CONE EDGE PROPERTIES,  STAGNATION
C          ENTHALPY AND PRESSURE
      HSPTO=(0.24D0*TINF&20.D-6*V*V)/33.86D0
      HS=32.96D0*HSPTO
      PINFPS=(2.D0/((GAMMA&1.D0)*MINF2    ))**(GAMMA/(GAMMA-1.D0))
      PINFPS=PINFPS*((2.D0*GAMMA*MINF2    -GAMMA&1.D0)/(GAMMA&1.D0))**(1
     X.D0/(
     1GAMMA-1.D0))
      PS=PINF/PINFPS
      QP=0.5D0*RHOINF*V*V
      REYL=RHOINF*V*CAPL/MUINF
      SINTM=MINF*SINT
      VE=V*SQRT(1.D0-1.40D0*SINTM**1.90D0/(MINF2))
      PE=PINF*(1.D0&2.8D0*SINTM*SINTM*(2.5D0&0.D0*SINTM)/(1.D0&16.D0*SIN
     XTM))
      IF(SINTM.GE.5.70D0)GO TO 1
      TETINF=1.D0&SINTM*(0.0966D0&0.22670D0*SINTM)
      GO TO 2
    1 TETINF=0.D0
      DO 3 K=1,3
      KK=K-1
      ISUB1=50&5*KK
      PTEM=(PINF/2116.2D0)**KK
      DO 3 I=1,5
      II=I-1
      ISUB=ISUB1&II
    3 TETINF=TETINF&A(ISUB)*(SINTM**II)*PTEM
    2 TE=TETINF*TINF
      RHOE=PE/(R*TE)
      ME=VE*MINF/(V*SQRT(TETINF))
      MUE= TEMTC**TE**1.5D0/(TE&198.6D0)
      REYES=RHOE*VE*S/MUE
C
      IF(TRZTR.EQ.0.D0)GO TO 46
C         TRANSITION ALTITUDE IS INPUT
      ZTR=TRZTR
      GO TO 45
C
C         TRANSITION ALTITUDE IS CALCULATED
   46 CONTINUE
      ZTR=0.D0
      DO 8 J=1,2
      JJ=J-1
      ISUB1=30&JJ
      TEMJ=CAPL**JJ
      DO 8 I=1,2
      II=I-1
      ISUB2=ISUB1&2*II
      TEMI=THETAD**II
      IF(THETAD.GT.15.D0)TEMI=(15.D0)**II
      DO 8 K=1,2
      KK=K-1
      ISUB=ISUB2&8*KK
      TEMO=A(ISUB)*TEMJ*TEMI
      TEML=LAMDA
      IF(LAMDA.GT.0.3D0)TEML=0.3D0
      IF(KK.NE.0)TEMO=TEMO*TEML**KK
```

```
    8 ZTR=ZTR&TEMO
   45 CONTINUE
C
      IF(Z.GE.ZTR)J=2
      IF(Z.LT.ZTR)J=3
C
C        CALCULATION OF CONSTANT PRESSURE SPECIFIC HEAT AT THE EDGE OF
C         SHARP CONE BOUNDARY LAYER
      IF(TE.GT.5000.D0)CPE=A(111)&A(112)*TE
      IF(TW(J,8).GT.5000.D0)CPW=A(111)&A(112)*TW(J,8)
      IF(TE.LT.700.D0)CPE=.2398D0
      IF(TW(J,8).LT.700.D0)CPW=0.2398D0
      IF(TE.GT.5000.D0)GO TO 4
      IF(TE.LT.700.D0)GO TO 4
      CPE=0.D0
      DO 5 I=1,6
      II=I-1
    5 CPE=CPE&A(II&105)*TE**II
C
C        CALCULATION OF CONSTANT PRESSURE SPECIFIC HEAT AT WALL
    4 IF(TW(J,8).GT.5000.D0)GO TO 6
      IF(TW(J,8).LT.700.D0)GO TO 6
      CPW=0.D0
      DO 7 I=1,6
      II=I-1
    7 CPW=CPW&A(II&105)*TW(J,8)**II
    6 CONTINUE
C
      HWBAR=CPW*TW(J,8)/33.86D0
      MUW=TEMTEM*TW(J,8)**1.5D0/(TW(J,8)&198.6D0)
C
C        CALCULATION OF XBAR, VISCOUS INTERACTION PARAMETER, USED IN
C         DETERMINING START OF CONTINUUM FLOW REGIME
      CE=MUW*TE/(MUE*TW(J,8))
      XBAR=ME*ME*ME*SQRT(CE/REYES)
C
C        CALCULATION OF RAREFACTION PARAMETER USED IN DETERMINING END
C         OF FREE MOLECULE AND THE START OF STRONG INTERACTION REGIME
      CINF=MUW*TINF/(MUINF*TW(J,8))
      XBARST=MINF*SQRT(CINF/(REYL*S/CAPL))/(SINT*SINT)
      XBAR1=XBARST*SINT*SINT
C
      IF(LOPT.EQ.3)GO TO 91
C
C        DELW2=WEIGHT LOSS DUE TO ABLATION,  DELW3=WEIGHT LOSS DUE TO
C         THRUSTING,  DELW=TOTAL WEIGHT LOSS,  WTOTAL=TOTAL WEIGHT OF
C         VEHICLE
      DELW2=WO-W
      DELW3=WO-WTH
      DELW=DELW2&DELW3
      WTOTAL=WO-DELW
      IF(WTOTAL.GT.0.D0)GO TO 91
      WRITE(6,1091)WTOTAL
 1091 FORMAT( 1H0,10X,'*****WARNING***** WTOTAL =',E11.4,' IS NOT ACCEPTA
     1BLE' )
      LP=6
C
   91 CONTINUE
      M=WTOTAL/G
      RETURN
```

END PPFL I360

```
CRANDOM
      FUNCTION  RANDOM(X)
      IMPLICIT REAL*8 (A-H,O-Z)
C
C
C         SUBROUTINE RANDOM IS A DUMMY SUBROUTINE.
C
C
      RANDOM = X
      RETURN
      END
```

```
CRCSEC
C
      SUBROUTINE RCSEC(B1,ZNET,WAKEL,SIGP,NOPT)
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON OCCUR,NOCCUR
      COMMON /CRCSEC/ F,TAU,SIGMOS,PHI,XBZ,ZME,HH,DDW,C1,C2,C3,C4,C5
      COMMON /DRCSEC/ BZERO,B2,B3,BTWEN,B24,DX,ZNUS,CNE,DSB,X2BOD,X3B,
     1IND2,NSTWL
      COMMON /CSIG/ XTT,WS1,XODP,DWST,SPH2,XLMS,XMSP,XSSP,CB1,ZCR2,ZCR4,
     1XB20,DWBSTL,SPH4,B0,CODW,WS4,CIGMOS,INDO
      DIMENSION OCCUR(4000),NOCCUR(30)
      EQUIVALENCE (OCCUR(4000),LP)
C
C
C         SUBROUTINE RCSEC COMPUTES THE RADAR CROSS SECTION AND PULSE
C      SHAPES FROM THE GIVEN OBSERVING RADAR AND THE TRANSITION POINT
C      ELECTRON DENSITY OF THE VEHICLE AND ALSO COMPUTES WAKE LENGTH.
C
C
C
C         IND2=0 - NO OUTPUT GENERATED BY THIS ROUTINE
C         IND2=1 - INTERMEDIATE STEPS PRINTED OUT
C         ALTITUDE INDEPENDENT QUANTITIES
C           SCALING CONSTANTS - BZERO,B2,B3,BTWEN,B24
C           SCALING CONSTANTS - XB0,B2,B3,XB20,B24
C           FREQUENCY - F
C           PULSE LENGTH - TAU
C           SEA LEVEL COLLISION FREQ. - ZNUS
C           PRESET CONSTANTS - C1,C2,C3,C4,C5
C           NOISE LEVEL TO WHICH WAKE LENGTH IS MEASURED - SIGMOS
C           STEP IN AXIAL COORDINATE - DX
C           MAXIMUM NUMBER OF STEPS USED TO COMPUTE WAKE LENGTH - NSTWL
C         ALTITUDE DEPENDENT QUANTITIES
C           ALTITUDE - HH
C           MACH NUMBER(UPSTREAM) - ZME
C           LOOK ANGLE - PHI
C           WAKE DIAMETER = BASE DIAM. - DDW
C           SCALE HEIGHT - XBZ
C           TRANSITION POINT ELECTRON DENSITY - ZNET
C         2 BODY OVERDENSE LENGTH - X2BOD
C         STATION WHERE LINEAR PRODUCTION TERMS FIRST DOMINATE OVER
C           NON-LINEAR PRODUCTION TERMS - X3B
C         TRANSITION ELECTRON DENSITY WHEN NONLINEAR PRODUCTION TERMS
C           ARE CONSIDERED IN TURBULENT WAKE - CNE
C         ADDITIONAL RCS DUE TO CONSIDERATION ON NONLINEAR PRODUCTION
C           TERMS IN TURBULENT WAKE - DSB
      CB1 = B1
      CODW = DDW
      CIGMOS = SIGMOS
      XB20 = BTWEN
      INDO = IND2
 200  F2 = F* F
      ZK = 6.283185308D-9 * F2
      WC1 =  F2/1.0D8
      ZNS2= ZNUS * ZNUS
C
C       RO - ATMOSPHERIC DENSITY AS A FUNCTION OF ALTITUDE
      RO = DEXP(-HH/XBZ)
C
```

```
C          ZNCR - ELECTRON DENSITY AT WHICH THE PLASMA BECOMES OVERDENSE
         ZNCR = WC1*((1.0D0 + RO * RO * ZNS2/F2)**C5)
C
C          XTT - TRANSITION PT. ONSET OF OVERDENSE REGION
         XTT = C1/RO * (1.0D0 -C2/(ZNE ** C3)) + C4
         ZNNCR= ZNET/ZNCR
         WS4 = ZNNCR ** XB20
         WCR2 = CNE * CNE/(ZNCR * ZNCR)
         IF(PHI)605,604,605
  604    PHI = 0.01D0
  605    IF(PHI -90.0D0)790,790,791
  791    PHI = 180.0D0 - PHI
C
C          CONVERT PHI  TO RADIANS AND FIND ITS SINE AND COSINE
  790    PH = PHI * 1.745329250-2
           SPH = DSIN(PH)
           CPH = DCOS(PH)
        SPH2 = SPH * SPH
         SPH4  = SPH2 * SPH2
C
C          TEST TO PREVENT OVERFLOW (COS 90 = 0)
         IF(PHI-90.0D0)606,607,606
  607    WS1 = 5000.0D0
         GO TO 608
  606    WS1 = 150.0D0 * TAU/CPH
  608    ZCR2 = ZNNCR * ZNNCR
         ZCR4 = ZCR2* ZCR2
          WS7 = B1 * XB20
C
C          XOD - ONSET OF CONSTANT MULTIPLE SCATTERING REGION
         XOD = X2BOD
         IF(X2BOD-X38)53,51,51
   51    XOD= DLOG(ZCR2)/B1
   53    IF(XOD)1,2,2
    1     CLOD = 0.0D0
C
C          COMPUTE XODP WHICH WILL REPLACE XOD IN ALL EQUATIONS -
C            XODP = XOD OR 0.0 IF XOD IS NEGATIVE
          XODP = 0.0D0
          GO TO 3
     2 CLOD = DMIN1(WS1,XOD)
        XODP = XOD
C
C          XSS - PT. OF ONSET OF SINGLE SCATTERING REGION
     3 XSS = DLOG(ZCR2/SPH4)/B1
        IF(IN02-1)30000,10000,30000
10000 WRITE (6,20000) RO,XTT,ZNCR,ZNNCR,XOD
20000 FORMAT(18X,7H    RO=,1PE15.7,6H   XT=,1PE15.7,6H NECR=,1PE15.7,10H
     1 NET/NECR=,1PE15.7,6H  XOD=,1PE15.7)
30000   IF(XSS)4,5,5
     4 CLSS = 0.0D0
C
C          COMPUTE XSSP WHICH WILL REPLACE XSS IN ALL EQUATIONS -
C            XSSP = XSS OR 0.0 IF XSS IS NEGATIVE
        XSSP = 0.0D0
         GO TO 6
     5 CLSS = DMIN1(WS1,XSS)
        XSSP = XSS
     6  CONTINUE
        IF(IN02-1)30001,10001,30001
```

```
10001 WRITE (6,20001) CLOD,XODP,XSS,CLSS,XSSP
20001 FORMAT(18X,7H  CLOD=,1PE15.7,6H XODP=,1PE15.7,6H  XSS=,1PE15.7,10H
     1      CLSS=,1PE15.7,6H XSSP=,1PE15.7)
30001  DDW2 = DDW * DDW
       DDW2 = DDW * DDW
       DDW4 = DDW2 * DDW2
      XXXX = (ZK * B24 * DDW)**3
C
C         DWST - SURFACE SCATTERING CORRECTION TERM FOR BASE DIAMETER
      DWST =(XXXX/(2.0D0 * SPH2 & XXXX)) * DDW
      DEN = (1.0D0 &B2 *F2/1.0D8 * DDW2)**B3
      B0 =(BZERO* (F2/1.0D8)**2 * DDW4)/DEN
      DWB1= DDW * SPH2/B1
      DWBST1 = DWST * SPH2/B1
       IF(XB20)800,801,800
C
C         XMS - PT. OF ONSET OF VARIABLE MULTIPLE SCATTERING REGION
  801 XMS = XODP
      GO TO 802
  800 CONTINUE
      XMS = 2.0D0 * DLOG(B0 * WS4 * SPH**(2.0D0*(1.0D0- XB20))*2.0D0)/
     1 WS7
  802  IF(XMS-XODP)760,761,761
  760  XMSP = XODP
      GO TO 762
  761 XMSP = XMS
  762 XLMOD = DMAX1(XMSP,XODP)
       IF(IND2-1)30002,10002,30002
10002 WRITE (6,20002) XXXX,DWST,DEN,B0,XMS
20002 FORMAT(18X,7H  XXXX=,1PE15.7,6H DWST=,1PE15.7,6H  DEN=,1PE15.7,10H
     1         B0=,1PE15.7,6H  XMS=,1PE15.7)
30002  XLMSD = DMIN1(XLMOD,WS1)
      XLMS = 0.0D0
      IF(XMSP-XODP)742,742,743
  743 XLMS = (XMSP-XODP)/2.0D0
      XLMS = DMIN1(0.5D0 * (WS1-XODP),XLMS)
      XLMS = DMAX1(0.0D0,XLMS)
  742  CONTINUE
      WS6 = X3B/WS1
      E1 = DEXP(-B1 * CLOD)
      E2 = DEXP(-B1 * CLSS)
      E3 = DEXP(-B1 * WS1)
      SPH16 = SPH2/16.0D0
      TRM1 = CLOD * DWST * SPH2 & DWST/B1*ZCR2*((E1-E3)*SPH16
     1& B0 *(E2-E3)) & XLMS * DWST * SPH2
       IF(IND2-1)30003,10003,30003
10003 WRITE (6,20003) XLMSD,XLMS,TRM1,E1,E2
20003 FORMAT(18X,7H XLMSD=,1PE15.7,6H XLMS=,1PE15.7,6H TRM1=,1PE15.7,10H
     1          E1=,1PE15.7,6H    E2=,1PE15.7)
30003  CONTINUE
      E1 = DEXP(-4.0D0 * B1 * CLOD) - DEXP(-4.0D0*WS1 * B1)
C
C         THE FOLLOWING TEST IS USED TO PREVENT UNDERFLOW
       IF(DABS(E1) - 1.0D-6)9005,9005,9006
 9005  E1 = 0.0D0
 9006 CONTINUE
       IF(XB20)780,781,780
  780 E2 = DEXP(-0.5D0 * WS7 * XLMSD) - DEXP(-WS7 * CLSS/2.0D0)
C
C         SIGP - PEAK WAKE RADAR CROSS SECTION
```

```
      SIGP = TRM1 & DWST * SPH2 * ZCR4*0.25D0/B1*E1*ZCR4 &2.0D0*B0*SPH2
     1 **(2.0D0 - XB20)/WS7 * ZNNCR**XB20 * E2 * DWST
      GO TO 782
  781 SIGP = TRM1 & 0.25D0*DWST*SPH2/B1*ZCR4*E1*ZCR4&B0*SPH4
     1 * (CLSS - XLMSD)       * DDW
  782 CONTINUE
      IF(IND2-1)30004,10004,30004
10004 WRITE (6,20004) SIGP
20004 FORMAT(18X,7H  SIGP=,1PE15.7 //)
C
C        THE FOLLOWING SET OF STATEMENTS COMPUTE THE WAKE LENGTH(WAKEL)
30004 WAKEL = 0.0D0
C
C        NOPT = 0, COMPUTE SIGP ONLY
C        NOPT = 1, COMPUTE SIGP AND WAKEL
C
      IF(NOPT)65,900,65
   65 J = 0
      N1 = NSTWL &1
      IT = 1
      NF = 1
C
  740 XJ = DFLOAT(J)
      XX = XJ * DX  &XTT
       SIG = FUN1(XX,NF)
      IF(J-N1)750,750,751
C
  751 WRITE (6,20005)
20005 FORMAT(2X,69HWARNING-NUMBER OF STEPS REQUIRED TO COMPUTE WAKE LENG
     1TH EXCEEDS NSTWL /)
        LP = 6
     RETURN
C
C
  750 GO TO (731,732,733),IT
  731 XL1 = XX
      IT = 2
  734 J = J&1
      XN = XX
      SIGN = SIG
      GO TO 740
C
  732 IT = 3
      GO TO 734
C
C
C
  733 IF(SIG-SIGN)736,736,735
  735  XL1 = XN
       GO TO 734
  736 XH1 = XX
C
C
     CALL FIB1(XL1,XH1,1,1,1.0D-4,20,XPEAK,SPEAK)
C
C
      IF(SPEAK-SIGMDS)737,737,738
  737 WAKEL = 0.0D0
     RETURN
C
```

```
C                                                                       RCSEC240
  738  XN = XPEAK                                                       RCSEC241
       J = 1                                                            RCSEC242
  741  XJ = DFLOAT(J)                                                   RCSEC243
       XX = XPEAK & DX * XJ                                             RCSEC244
       SIG = FUN1(XX,NF)                                                RCSEC245
       IF(SIG - SIGMUS)739,739,7422                                     RCSEC246
 7422  J = J&1                                                          RCSEC247
       IF(J-N1)752,752,751                                              RCSEC248
  752  XN = XX                                                          RCSEC249
       GO TO 741                                                        RCSEC250
C                                                                       RCSEC251
  739   CALL FIB1(XN,XX,2,-1,1.0D-4,20,XNL,DUM)                         RCSEC252
C                                                                       RCSEC253
       WAKEL = XNL - XPEAK                                              RCSEC254
C                                                                       RCSEC255
  900  RETURN                                                           RCSEC256
       END                                                              RCSEC257
```

```
CREADIT
       IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE READIT(ILL111,IMPLOT)
C
C
C
C        SUBROUTINE READIT READS IN THE INPUT FOR ONE CASE AND TESTS
C           CERTAIN VALUES IN THE IOP ARRAY.
C
C
      REAL*8 LAMDA1,LAMDA2,LA1,LA2
      REAL*8  ISP,MW,NSL1,NSL2,NST1,NST2,NGL1,NGL2,NGT1,NGT2
C
      COMMON OCCUR,NOCCUR
      COMMON /CICCUR/ IOCCUR(320)
      DIMENSION IOP(90)
      DIMENSION ALPTAB(75),OCCUR(4000),NOCCUR(30),NPLOT(5),
     1          CHIGH(16),CDOWN(16),THTHO(25),THDELZ(25),THDELT(25),
     2          TXCGD1(50),TXCGD2(50),TABI1(50),TABI2(50),TABIX1(50),
     3           TABZ1(50),TABZ2(50),HTAB(75),WHTAB(75),COTAB(75),
     4           TABIX2(50),WCDTAB(75)
      DIMENSION  WTZ(75),WTMINF(75),WTKINF(75),WFPTOT(75),TRAJT(75),
     1           TRAJZ(75),TRAJV(75),TRAJW(75),TRAJRN(75),TRJALP(75)
      DIMENSION TABRHO(50),TABSND(50),TBATMZ(50)
      DIMENSION  A(514),B(21)
C
      EQUIVALENCE (OCCUR(00301), A     )
      EQUIVALENCE (OCCUR(00214), AE    )
      EQUIVALENCE (OCCUR(03646), ALPTAB)
      EQUIVALENCE (OCCUR(00122), ALST  )
      EQUIVALENCE (OCCUR(00188), AWREF )
      EQUIVALENCE (OCCUR(00823), B     )
      EQUIVALENCE (OCCUR(00152), BETA11)
      EQUIVALENCE (OCCUR(00171), BETA12)
      EQUIVALENCE (OCCUR(00153), BETA21)
      EQUIVALENCE (OCCUR(00172), BETA22)
      EQUIVALENCE (OCCUR(00154), BETA31)
      EQUIVALENCE (OCCUR(00173), BETA32)
      EQUIVALENCE (OCCUR(00155), BETA41)
      EQUIVALENCE (OCCUR(00174), BETA42)
      EQUIVALENCE (OCCUR(00115), C     )
      EQUIVALENCE (OCCUR(00019), CAPG  )
      EQUIVALENCE (OCCUR(00128), CASE  )
      EQUIVALENCE (OCCUR(03549), CDOWN )
      EQUIVALENCE (OCCUR(03363), COTAB )
      EQUIVALENCE (OCCUR(03533), CHIGH )
      EQUIVALENCE (OCCUR(00124), CHUIN1)
      EQUIVALENCE (OCCUR(00125), CHUIN2)
      EQUIVALENCE (OCCUR(00161), CPG1  )
      EQUIVALENCE (OCCUR(00180), CPG2  )
      EQUIVALENCE (OCCUR(00160), CP21  )
      EQUIVALENCE (OCCUR(00179), CP22  )
      EQUIVALENCE (OCCUR(00127), DATE  )
      EQUIVALENCE (OCCUR(00166), DELHC1)
      EQUIVALENCE (OCCUR(00185), DELHC2)
      EQUIVALENCE (OCCUR(00187), DELIN )
      EQUIVALENCE (OCCUR(00159), DELRH1)
      EQUIVALENCE (OCCUR(00178), DELRH2)
      EQUIVALENCE (OCCUR(00119), DELY  )
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```
      EQUIVALENCE (OCCUR(00220), DELZ  )
      EQUIVALENCE (OCCUR(00248), DNBNDZ)
      EQUIVALENCE (OCCUR(00129),  EMO  )
      EQUIVALENCE (OCCUR(167), EPSIL1)
      EQUIVALENCE (OCCUR(00186), EPSIL2)
      EQUIVALENCE (OCCUR(00157), F1    )
      EQUIVALENCE (OCCUR(00176), F2    )
      EQUIVALENCE (OCCUR(00027), G     )
      EQUIVALENCE (OCCUR(00105), GAMFO )
      EQUIVALENCE (OCCUR(00028), GAMMA )
      EQUIVALENCE (OCCUR(00156),  HREF1)
      EQUIVALENCE (OCCUR(00175),  HREF2)
      EQUIVALENCE (OCCUR(03233), HTAB  )
      EQUIVALENCE (OCCUR(00222), ISP   )
      EQUIVALENCE (OCCUR(00137), LAMDA1)
      EQUIVALENCE (OCCUR(00143), LAMDA2)
      EQUIVALENCE (OCCUR(00138), LA1   )
      EQUIVALENCE (OCCUR(00144), LA2   )
      EQUIVALENCE (OCCUR(00117), MW    )
      EQUIVALENCE (OCCUR(00164), NGL1  )
      EQUIVALENCE (OCCUR(00183), NGL2  )
      EQUIVALENCE (OCCUR(00165), NGT1  )
      EQUIVALENCE (OCCUR(00184), NGT2  )
      EQUIVALENCE (OCCUR(00162), NSL1  )
      EQUIVALENCE (OCCUR(00181), NSL2  )
      EQUIVALENCE (OCCUR(00163), NST1  )
      EQUIVALENCE (OCCUR(00182), NST2  )
      EQUIVALENCE (OCCUR(00112), PHIO  )
      EQUIVALENCE (OCCUR(00223), PSIZET)
      EQUIVALENCE (OCCUR(00114), PSIO  )
      EQUIVALENCE (OCCUR(00109), PO    )
      EQUIVALENCE (OCCUR(00110), QO    )
      EQUIVALENCE (OCCUR(00057), R     )
      EQUIVALENCE (OCCUR(00136), RB1   )
      EQUIVALENCE (OCCUR(00142), RB2   )
      EQUIVALENCE (OCCUR(00063), RE    )
      EQUIVALENCE (OCCUR(00158), RHO21 )
      EQUIVALENCE (OCCUR(00177), RHO22 )
      EQUIVALENCE (OCCUR(00135), RN1   )
      EQUIVALENCE (OCCUR(00141), RN2   )
      EQUIVALENCE (OCCUR(00116), SIG   )
      EQUIVALENCE (OCCUR(00111), SMRO  )
      EQUIVALENCE (OCCUR(03033), TABIX1)
      EQUIVALENCE (OCCUR(03083), TABIX2)
      EQUIVALENCE (OCCUR(02933), TABI1 )
      EQUIVALENCE (OCCUR(02983), TABI2 )
      EQUIVALENCE (OCCUR(03771), TABRHO)
      EQUIVALENCE (OCCUR(03821), TABSNO)
      EQUIVALENCE (OCCUR(03133), TABZ1 )
      EQUIVALENCE (OCCUR(03183), TABZ2 )
      EQUIVALENCE (OCCUR(03721), TBATMZ)
      EQUIVALENCE (OCCUR(00077), TCRIT )
      EQUIVALENCE (OCCUR(00078), TECUN )
      EQUIVALENCE (OCCUR(03618), THDELT)
      EQUIVALENCE (OCCUR(03593), THDELZ)
      EQUIVALENCE (OCCUR(00113), THEALO)
      EQUIVALENCE (OCCUR(00134), THETA1)
      EQUIVALENCE (OCCUR(00140), THETA2)
      EQUIVALENCE (OCCUR(00224), THEZET)
      EQUIVALENCE (OCCUR(03568), THTHO )
```

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      EQUIVALENCE (OCCUR(00207), THO    )                               READ1120
      EQUIVALENCE (OCCUR(00132), TINIT  )                               READ1121
      EQUIVALENCE (OCCUR(00209), TOFF   )                               READ1122
      EQUIVALENCE (OCCUR(00208), TON    )                               READ1123
      EQUIVALENCE (OCCUR(01644), TRAJRN)                                READ1124
      EQUIVALENCE (OCCUR(01344), TRAJT )                                READ1125
      EQUIVALENCE (OCCUR(01494), TRAJY )                                READ1126
      EQUIVALENCE (OCCUR(01569), TRAJW )                                READ1127
      EQUIVALENCE (OCCUR(01419), TRAJZ )                                READ1128
      EQUIVALENCE (OCCUR(01719), TRJALP)                                READ1129
      EQUIVALENCE (OCCUR(00243), TRZTR )                                READ1130
      EQUIVALENCE (OCCUR(00123), TST    )                               READ1131
      EQUIVALENCE (OCCUR(00148), TWST   )                               READ1132
      EQUIVALENCE (OCCUR(00149), TW1    )                               READ1133
      EQUIVALENCE (OCCUR(00168), TW2    )                               READ1134
      EQUIVALENCE (OCCUR(02833), TXCGD1)                                READ1135
      EQUIVALENCE (OCCUR(02883), TXCGD2)                                READ1136
      EQUIVALENCE (OCCUR(00102), TO     )                               READ1137
      EQUIVALENCE (OCCUR(00247), UPBNOZ)                                READ1138
      EQUIVALENCE (OCCUR(00106), VO     )                               READ1139
      EQUIVALENCE (OCCUR(03458), WCDTAB)                                READ1140
      EQUIVALENCE (OCCUR(03308), WHTAB )                                READ1141
      EQUIVALENCE (OCCUR(01119), WTMINF)                                READ1142
      EQUIVALENCE (OCCUR(01269), WTPTOT)                                READ1143
      EQUIVALENCE (OCCUR(01194), WTRINF)                                READ1144
      EQUIVALENCE (OCCUR(01044), WTZ    )                               READ1145
      EQUIVALENCE (OCCUR(00133), W1     )                               READ1146
      EQUIVALENCE (OCCUR(00139), W2     )                               READ1147
      EQUIVALENCE (OCCUR(00238), XLOW   )                               READ1148
      EQUIVALENCE (OCCUR(00107), XRO    )                               READ1149
      EQUIVALENCE (OCCUR(00237), XUP    )                               READ1150
      EQUIVALENCE (OCCUR(00240), X1LOW  )                               READ1151
      EQUIVALENCE (OCCUR(00239), X1UP   )                               READ1152
      EQUIVALENCE (OCCUR(00120), ZBAR   )                               READ1153
      EQUIVALENCE (OCCUR(00093), ZETA   )                               READ1154
      EQUIVALENCE (OCCUR(00206), ZOFF   )                               READ1155
      EQUIVALENCE (OCCUR(00205), ZON    )                               READ1156
      EQUIVALENCE (OCCUR(00118), ZPR1   )                               READ1157
      EQUIVALENCE (OCCUR(00119), ZPR2   )                               READ1158
      EQUIVALENCE (OCCUR(00121), ZST    )                               READ1159
      EQUIVALENCE (OCCUR(00145), ZTURN)                                 READ1160
      EQUIVALENCE (OCCUR(00109), ZO     )                               READ1161
      EQUIVALENCE (NOCCUR(08), IATMOS)                                  READ1162
      EQUIVALENCE (NOCCUR(09), IKCMU )                                  READ1163
      EQUIVALENCE (NOCCUR(30), INALPH)                                  READ1164
      EQUIVALENCE (NOCCUR(29), ITAPE )                                  READ1165
      EQUIVALENCE (NOCCUR(23), ITHRST)                                  READ1166
      EQUIVALENCE (NOCCUR(07), LJPT  )                                  READ1167
      EQUIVALENCE (NOCCUR(20), MATLN1)                                  READ1168
      EQUIVALENCE (NOCCUR(21), MATLN2)                                  READ1169
      EQUIVALENCE (NOCCUR(06), MAXVAL)                                  READ1170
      EQUIVALENCE (NOCCUR(10), MHEAT)                                   READ1171
      EQUIVALENCE (NOCCUR(16), MXTAB1)                                  READ1172
      EQUIVALENCE (NOCCUR(17), MXTAB2)                                  READ1173
      EQUIVALENCE (NOCCUR(18), MAXCD )                                  READ1174
      EQUIVALENCE (NOCCUR(19), MAXWCD)                                  READ1175
      EQUIVALENCE (NOCCUR(15), NGEOM )                                  READ1176
      EQUIVALENCE (NOCCUR(03), NOPT  )                                  READ1177
      EQUIVALENCE (NOCCUR(005), NOSEDP)                                 READ1178
      EQUIVALENCE (NOCCUR(24), NPLOT )                                  READ1179
```

```
      EQUIVALENCE (NOCCUR(14), NPRINT)
      EQUIVALENCE (NOCCUR(22), NTHRST)
      EQUIVALENCE (IOCCUR(00001), IOP    )
C
C
      DATA INCOL1/8888/
C
C
C
      GO TO (1,2),ILL111
    1 CONTINUE
      CALL ZREADX
      CALL SETUP(8HOCCUR    ,8,OCCUR,4000)
C
C          CASE IDENTIFICATION INPUTS
      CALL SETUP(8HCASE     ,8,CASE   )
      CALL SETUP(8HDATE     ,8,DATE   )
      CALL SETUP(8HMEMO     ,8,EMO    )
C
C          PRINTING AND STOP CONTROLS
      CALL SETUP(8HNPRINT   ,4,NPRINT)
      CALL SETUP(8HZPR1     ,8,ZPR1   )
      CALL SETUP(8HZBAR     ,8,ZBAR   )
      CALL SETUP(8HZPR2     ,8,ZPR2   )
      CALL SETUP(8HZST      ,8,ZST    )
      CALL SETUP(8HTST      ,8,TST    )
      CALL SETUP(8HALST     ,8,ALST   )
C
C          INTEGRATION ACCURACY CONTROLS
      CALL SETUP(8HDELIN    ,8,DELIN )
      CALL SETUP(8HCHIGH    ,8,CHIGH ,16)
      CALL SETUP(8HCDOWN    ,8,CDOWN ,16)
C
C          INPUT TRANSITION ALTITUDE  TRZTR
      CALL SETUP(8HTRZTR    ,8,TRZTR )
C
C          INPUT LIMITS ON THE FAIRING REGIONS
      CALL SETUP(8HX1UP     ,8,X1UP   )
      CALL SETUP(8HX1LOW    ,8,X1LOW  )
      CALL SETUP(8HXUP      ,8,XUP    )
      CALL SETUP(8HXLOW     ,8,XLOW   )
C
C          TRAJECTORY OPTION AND INITIAL VALUES OF TRAJECTORY PARAMETERS
      CALL SETUP(8HLOPT     ,4,LOPT   )
      CALL SETUP(8HZ0       ,8,Z0     )
      CALL SETUP(8HGAMF0    ,8,GAMF0  )
      CALL SETUP(8HV0       ,8,V0     )
      CALL SETUP(8HT0       ,8,T0     )
      CALL SETUP(8HXR0      ,8,XR0    )
      CALL SETUP(8HP0       ,8,P0     )
      CALL SETUP(8HQ0       ,8,Q0     )
      CALL SETUP(8HSMR0     ,8,SMR0   )
      CALL SETUP(8HPHI0     ,8,PHI0   )
      CALL SETUP(8HPSI0     ,8,PSI0   )
      CALL SETUP(8HTHEAL0   ,8,THEAL0)
C
C          INPUT TEST QUANTITIES FOR ANGLE OF ATTACK CYCLE TIME
      CALL SETUP(8HTCRIT    ,8,TCRIT )
      CALL SETUP(8HTECON    ,8,TECON )
C
```

```
C          NUMBER OF TABULAR INPUTS FOR EITHER THE INPUT WIND TUNNEL      READI240
C       OPTION OR THE INPUT TRAJECTORY OPTION.                            READI241
      CALL SETUP(8HMAXVAL  ,4,MAXVAL)                                     READI242
C                                                                         READI243
C          INPUTS FOR WIND TUNNEL OPTION                                  READI244
      CALL SETUP(8HWTZ     ,8,WTZ,75)                                     READI245
      CALL SETUP(8HWTMINF  ,8,WTMINF,75)                                  READI246
      CALL SETUP(8HWTRINF  ,8,WTRINF,75)                                  READI247
      CALL SETUP(8HWTPTOT  ,8,WTPTOT,75)                                  READI248
C                                                                         READI249
C          INPUTS FOR TABULAR INPUT TRAJECTORY                            READI250
      CALL SETUP(8HTRAJT   ,8,TRAJT,75)                                   READI251
      CALL SETUP(8HTRAJZ   ,8,TRAJZ,75)                                   READI252
      CALL SETUP(8HTRAJV   ,8,TRAJV,75)                                   READI253
      CALL SETUP(8HTRAJW   ,8,TRAJW,75)                                   READI254
      CALL SETUP(8HTRAJRN  ,8,TRAJRN,75)                                  READI255
      CALL SETUP(8HTRJALP  ,8,TRJALP,75)                                  READI256
C                                                                         READI257
C          TABULAR INPUT ANGLE OF ATTACK FOR USE WITH LOPT=1 TRAJECTORY   READI258
      CALL SETUP(8HINALPH  ,4,INALPH)                                     READI259
      CALL SETUP(8HALPTAB  ,8,ALPTAB,75)                                  READI260
C                                                                         READI261
C          MASS LOSS OPTION INPUTS                                        READI262
      CALL SETUP(8HMOPT    ,4,MOPT  )                                     READI263
      CALL SETUP(8HMHEAT   ,4,MHEAT )                                     READI264
      CALL SETUP(8HNOSEOP  ,4,NOSEOP)                                     READI265
C                                                                         READI266
C          TWST IS A WALL TEMPERATURE USED IN RAREFIED FLOW CALCULATIONSREADI267
      CALL SETUP(8HTWST    ,8,TWST  )                                     READI268
C                                                                         READI269
C          TINIT IS INTERNAL TEMPERATURE OF VEHICLE USED TO OBTAIN        READI270
C       TEMPERATURE GRADIENT IN MASS LOSS CALCULATIONS USING THE          READI271
C       ITERATIVE METHOD.                                                 READI272
      CALL SETUP(8HTINIT   ,8,TINIT )                                     READI273
C                                                                         READI274
C          OPTION INDICATING THE SET OF GEOMETRIC VARIABLES BEING INPUT   READI275
      CALL SETUP(8HNGEOM   ,4,NGEOM )                                     READI276
C          OPTION TO INPUT CMQ                                            READI277
      CALL SETUP(8HIKCMQ   ,4,IKCMQ )                                     READI278
C          GEOMETRY INPUTS FOR THE FIRST CONFIGURATION                    READI279
      CALL SETUP(8HW1      ,8,W1    )                                     READI280
      CALL SETUP(8HTHETA1  ,8,THETA1)                                     READI281
      CALL SETUP(8HRN1     ,8,RN1   )                                     READI282
      CALL SETUP(8HRB1     ,8,RB1   )                                     READI283
      CALL SETUP(8HLAMDA1  ,8,LAMDA1)                                     READI284
      CALL SETUP(8HLA1     ,8,LA1   )                                     READI285
      CALL SETUP(8HMXTAB1  ,4,MXTAB1)                                     READI286
      CALL SETUP(8HCMQIN1  ,8,CMQIN1)                                     READI287
      CALL SETUP(8HTABZ1   ,8,TABZ1 ,50)                                  READI288
      CALL SETUP(8HTXCG01  ,8,TXCG01,50)                                  READI289
      CALL SETUP(8HTABI1   ,8,TABI1 ,50)                                  READI290
      CALL SETUP(8HTABIX1  ,8,TABIX1,50)                                  READI291
C                                                                         READI292
C          FIRST CONFIGURATION HEATSHIELD PROPERTIES                      READI293
      CALL SETUP(8HMATLN1  ,4,MATLN1)                                     READI294
      CALL SETUP(8HTW1     ,8,TW1   )                                     READI295
      CALL SETUP(8HBETA11  ,8,BETA11)                                     READI296
      CALL SETUP(8HBETA21  ,8,BETA21)                                     READI297
      CALL SETUP(8HBETA31  ,8,BETA31)                                     READI298
      CALL SETUP(8HBETA41  ,8,BETA41)                                     READI299
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```
      CALL SETUP(8HHREF1   ,8,HREF1 )                                     READ1300
      CALL SETUP(8HF1      ,8,F1    )                                     READ1301
      CALL SETUP(8HRHO21   ,8,RHO21 )                                     READ1302
      CALL SETUP(8HDELRH1  ,8,DELRH1)                                     READ1303
      CALL SETUP(8HCP21    ,8,CP21  )                                     READ1304
      CALL SETUP(8HCPG1    ,8,CPG1  )                                     READ1305
      CALL SETUP(8HNSL1    ,8,NSL1  )                                     READ1306
      CALL SETUP(8HNST1    ,8,NST1  )                                     READ1307
      CALL SETUP(8HNGL1    ,8,NGL1  )                                     READ1308
      CALL SETUP(8HNGT1    ,8,NGT1  )                                     READ1309
      CALL SETUP(8HDELHC1  ,8,DELHC1)                                     READ1310
      CALL SETUP(8HEPSIL1  ,8,EPSIL1)                                     READ1311
C                                                                         READ1312
C     ZTURN IS ALTITUDE FOR DISCONTINUOUS CONFIGURATION CHANGE            READ1313
      CALL SETUP(8HZTURN   ,8,ZTURN )                                     READ1314
C                                                                         READ1315
C          GEOMETRY INPUTS FOR THE SECOND CONFIGURATION                   READ1316
      CALL SETUP(8HW2      ,8,W2    )                                     READ1317
      CALL SETUP(8HTHETA2  ,8,THETA2)                                     READ1318
      CALL SETUP(8HRN2     ,8,RN2   )                                     READ1319
      CALL SETUP(8HRB2     ,8,RB2   )                                     READ1320
      CALL SETUP(8HLAMDA2  ,8,LAMDA2)                                     READ1321
      CALL SETUP(8HLA2     ,8,LA2   )                                     READ1322
      CALL SETUP(8HMXTAB2  ,4,MXTAB2)                                     READ1323
      CALL SETUP(8HCMQIN2  ,8,CMQIN2)                                     READ1324
      CALL SETUP(8HTABZ2   ,8,TABZ2 ,50)                                  READ1325
      CALL SETUP(8HTXCGD2  ,8,TXCGD2,50)                                  READ1326
      CALL SETUP(8HTABI2   ,8,TABI2 ,50)                                  READ1327
      CALL SETUP(8HTABIX2  ,8,TABIX2,50)                                  READ1328
C                                                                         READ1329
C          SECOND CONFIGURATION HEATSHIELD PROPERTIES                     READ1330
      CALL SETUP(8HMATLN2  ,4,MATLN2)                                     READ1331
      CALL SETUP(8HTW2     ,8,TW2   )                                     READ1332
      CALL SETUP(8HBETA12  ,8,BETA12)                                     READ1333
      CALL SETUP(8HBETA22  ,8,BETA22)                                     READ1334
      CALL SETUP(8HBETA32  ,8,BETA32)                                     READ1335
      CALL SETUP(8HBETA42  ,8,BETA42)                                     READ1336
      CALL SETUP(8HHREF2   ,8,HREF2 )                                     READ1337
      CALL SETUP(8HF2      ,8,F2    )                                     READ1338
      CALL SETUP(8HRHO22   ,8,RHO22 )                                     READ1339
      CALL SETUP(8HDELRH2  ,8,DELRH2)                                     READ1340
      CALL SETUP(8HCP22    ,8,CP22  )                                     READ1341
      CALL SETUP(8HCPG2    ,8,CPG2  )                                     READ1342
      CALL SETUP(8HNSL2    ,8,NSL2  )                                     READ1343
      CALL SETUP(8HNST2    ,8,NST2  )                                     READ1344
      CALL SETUP(8HNGL2    ,8,NGL2  )                                     READ1345
      CALL SETUP(8HNGT2    ,8,NGT2  )                                     READ1346
      CALL SETUP(8HDELHC2  ,8,DELHC2)                                     READ1347
      CALL SETUP(8HEPSIL2  ,8,EPSIL2)                                     READ1348
C                                                                         READ1349
C          DRAG COEFFICIENT INPUTS                                        READ1350
      CALL SETUP(8HMAXCD   ,4,MAXCD )                                     READ1351
      CALL SETUP(8HHTAB    ,8,HTAB  ,75)                                  READ1352
      CALL SETUP(8HCDTAB   ,8,CDTAB ,75)                                  READ1353
C                                                                         READ1354
C          INCREMENT IN DRAG COEFF. INPUTS                                READ1355
      CALL SETUP(8HMAXWCD  ,4,MAXWCD)                                     READ1356
      CALL SETUP(8HWHTAB   ,8,WHTAB ,75)                                  READ1357
      CALL SETUP(8HWCDTAB  ,8,WCDTAB,75)                                  READ1358
      CALL SETUP(8HAWREF   ,8,AWREF )                                     READ1359
```

```
C
C          THRUSTING OPTION INPUTS
      CALL SETUP(8HNTHRUST ,4,NTHRST)
      CALL SETUP(8HTON     ,8,TON   )
      CALL SETUP(8HTOFF    ,8,TOFF  )
      CALL SETUP(8HZON     ,8,ZON   )
      CALL SETUP(8HZOFF    ,8,ZOFF  )
      CALL SETUP(8HITHRST  ,4,ITHRST)
      CALL SETUP(8HTHTHO   ,8,THTHO ,25)
      CALL SETUP(8HTHDELT  ,8,THDELT,25)
      CALL SETUP(8HTHDELZ  ,8,THDELZ,25)
      CALL SETUP(8HTHO     ,8,THO   )
      CALL SETUP(8HISP     ,8,ISP   )
      CALL SETUP(8HAE      ,8,AE    )
      CALL SETUP(8HPSIZET  ,8,PSIZET)
      CALL SETUP(8HTHEZET  ,8,THEZET)
      CALL SETUP(8HDELY    ,8,DELY  )
      CALL SETUP(8HDELZ    ,8,DELZ  )
C
C          INPUTS FOR TABULAR INPUT ATMOSPHERE
      CALL SETUP(8HIATMOS  ,4,IATMOS)
      CALL SETUP(8HUPBNDZ  ,8,UPBNDZ)
      CALL SETUP(8HLONBNDZ ,8,LNBNDZ)
      CALL SETUP(8HTBATMZ  ,8,TBATMZ,50)
      CALL SETUP(8HTABRHO  ,8,TABRHO,50)
      CALL SETUP(8HTABSND  ,8,TABSND,50)
C
C          PLOTTING AND TAPE INPUTS
      CALL SETUP(8HNPLOT   ,4,NPLOT ,5)
      CALL SETUP(8HITAPE   ,4,ITAPE )
C
C          PHYSICAL CONSTANTS
      CALL SETUP(8HC       ,8,C     )
      CALL SETUP(8HR       ,8,R     )
      CALL SETUP(8HGAMMA   ,8,GAMMA )
      CALL SETUP(8HRE      ,8,RE    )
      CALL SETUP(8HCAPG    ,8,CAPG  )
      CALL SETUP(8HG       ,8,G     )
      CALL SETUP(8HZETA    ,8,ZETA  )
      CALL SETUP(8HSIG     ,8,SIG   )
      CALL SETUP(8HMW      ,8,MW    )
C
C          CURVE FIT CONSTANTS
      CALL SETUP(8HA       ,8,A,516)
      CALL SETUP(8HB       ,8,B,21)
C
    2 CALL READIN(INCOL1,$99)
      IOP(73) = 0
      DO 66 I = 1, 3
      J = I + 63
      IOP(J) = 0
       DO 55 K = I , 21 , 3
      IF(IOP(K).EQ.1) IOP(J) = 1
   55  CONTINUE
      IF(IOP(J).EQ.1) IOP(73) = 1
   66  CONTINUE
       IOP(74) = 0
      ITEM = 0
      DO 88 I = 22, 27
       J = I + 45
```

```
      IOP(J) = 0                                                        READ1420
       IF(IOP(J&10).EQ.1)  ITEM = 1                                     READ1421
       DO 77 K = I , 63 , 6                                             READ1422
        IF(IOP(K).EQ.1)  IOP(J) = 1                                     READ1423
77      CONTINUE                                                        READ1424
       IF(ITEM.EQ.1)  IOP(74) = 1                                       READ1425
      IF(IOP(J).EQ.1) IOP(74) = 1                                       READ1426
88    CONTINUE                                                          READ1427
      CALL HEDING(6)                                                    READ1428
      GO TO 98                                                          READ1429
99    IF(IMPLOT.EQ.1) CALL AVPLT(H,H,H,H,H,5,1)                         READ1430
      IF(ITAPE.NE.0)END FILE 8                                          READ1431
      IF(ITAPE.NE.0)REWIND 8                                            READ1432
      CALL EXIT                                                         READ1433
   98 RETURN                                                            READ1434
      END                                                               READ1435
```

```
CREADY
      SUBROUTINE READY
        IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/BLKO/ H(40,40),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FO,E, P,TO,RS,SL, Z,Q,A,EL,
     2DELTA,FAC,C(40,10)
      COMMON/BLK1/M,N,L,LS,M1,MS,NS,IT,K,NC
      COMMON /NALTFG/FGSM,NALT
      COMMON /END/ ITERM
C     READY
C
C
C           SUBROUTINE READY PERFORMS THE CALCULATIONS OF THE DAVIDON
C        MINIMIZATION METHOD WHICH ESTABLISH A DIRECTION ALONG WHICH TO
C        SEARCH FOR A RELATIVE MINIMUM AND BOX OFF AN INTERVAL IN
C        THIS DIRECTION WITHIN WHICH A RELATIVE MINIMUM IS LOCATED.
C
C
      L=L
      GO TO (200,201),L
  200 IT=1
  201 CALL MATMP (N,N,H,G,S)
C
  202 DO 203 I=1,N
  203 S(I)=-S(I)
C
  204 M=1
  205 CALL MATMP (M,N,S,G,GS)
  206 IF (GS&E)207,227,227
C
207   TP1 = -FGSM*(F/GS)
      WRITE(6,1000) GS, E, TP1, IT
      EL =  DMIN1(2.0D0, TP1)
  209 SL=-GS
C
  210 DO 211 I=1,N
  211 XP(I)=X(I)&EL*S(I)
C
  212 M1=2
  213 CALL FCN(N,GP,FP,XP,M1)
      IF(ITERM.EQ.0) GO TO 214
      DO 100I = 1,N
100   X(I) = XP(I)
      GO TO 222
C
  214 M=1
  215 CALL MATMP (M,N,S,GP,GSP)
  216 IF (GSP)217,229,229
  217 IF (FP-F)218,229,229
  218 WRITE(6,1)
C
      IF(NALT) 231, 231, 10
10    EL = 2.D0*EL
      GO TO 210
  231 FB=FP
  232 DO 234 I=1,N
  233 GB(I)=GP(I)
  234 T(I)=XP(I)
  220 IF (EL-2.0)221,223,223
```

```
  221 L=3
C
  222 RETURN
C
  223 DELTA=2.0*DELTA
  224 T0=1.0/SL
  225 L=2
  226 GO TO 222
  227 L=1
  228 GO TO 222
  229 L=4
  230 GO TO 222
C
    1 FORMAT (10HOUNDERSHOT)
1000  FORMAT(1H 'GS ='1PE15.7,' ERR ='E15.7,' TP1 ='E15.7,' IT ='I7)
      END
```

```
CREDUCE
      IMPLICIT REAL*8(A-H,O-Z)
      SUBROUTINE REDUCE(CUP,KRED,IRED,LRED,WRF)
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      COMMON OCCUR,NOCCUR
      COMMON /IDNUS/ ID1(50), ID2(50)
      COMMON/IOPT/IPROC,IN,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON /END/ ITERM
      DIMENSION CUP(20)
      DIMENSION OCCUR(4000),NOCCUR(30)
C
C
C           SUBROUTINE REDUCE CAN MULTIPLY ANY SPECIFIED ELEMENT OF THE
C         OCCUR ARRAY BY THE REDUCTION FACTOR WRF AND SET THE FIRST
C         ELEMENT OF THE CUP ARRAY EQUAL TO ANY SPECIFIED ELEMENT OF THE
C         OCCUR ARRAY MULTIPLIED BY THE FACTOR WRF.
C
C
C
      IZ = ID2(1)
      IRED = IRED & 1
      IF(IRED.EQ.LRED) GO TO 100
      IF(ITERM) 10, 50, 60
C
C
10    DO 20 I = 1, IN
      IF(ID1(I).EQ.IZ) GO TO 40
20    CONTINUE
C
      IF(ICOM(3).EQ.1) GO TO 40
C
30    OCCUR(IZ) = WRF*OCCUR(IZ)
      KRED = 0
      GO TO 200
C
40    CUP(1) = WRF*OCCUR(IZ)
      KRED = 0
      GO TO 200
C
50    KRED = 1
C      50 MAY BE USED FOR LATER IMPLEMENTATION
C
C
      GO TO 200
C
60    KRED = 1
      GO TO 200
C
C
100    KRED = -1
C
200   RETURN
      END
```

```
CRITOUT
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE RITOUT
C
      DIMENSION ALMAX(200),ALMIN(200),TAMAX(200),TAMIN(200),ZMAX(200),
     1ZMIN(200),FMAX(200),FMIN(200),OCCUR(4000),NOCCUR(30)
C
      EQUIVALENCE
     1(OCCUR(1044),ALMAX(1)),(OCCUR(1244),ALMIN(1)),
     2(OCCUR(1444),TAMAX(1)),(OCCUR(1644),TAMIN(1)),
     3(OCCUR(1844),ZMAX(1)), (OCCUR(2044), ZMIN(1)),
     4(OCCUR(2244),FMAX(1)), (OCCUR(2444), FMIN(1))
      EQUIVALENCE
     1(NOCCUR(11), IKMAX),(NOCCUR(12), IKMIN),(NOCCUR(14),NPRINT)
C
      COMMON OCCUR,NOCCUR
C
C
C           SUBROUTINE RITOUT PRINTS OUT A SUMMARY OF THE MAXIMUMS AND
C           MINIMUMS IN ANGLE OF ATTACK AS DETERMINED BY THE TESTING IN
C           SUBROUTINE VIXEN.
C
      IF(NPRINT.EQ.0)RETURN
   51 WRITE(6,1051)
 1051 FORMAT(1H0 50X,23HMAXIMUMS IN ALPHA PRIME/40X,4HTIME,9X,1HZ,12X,
     13HSMF,6X,11HALPHA PRIME)
C
      DO 52 J=1,IKMAX
      ALMAX(J)=57.29578D0*ALMAX(J)
      WRITE(6,1052)TAMAX(J),ZMAX(J),FMAX(J),ALMAX(J)
 1052 FORMAT(1H 38X,F7.2,2E14.5,4X,F8.3)
   52 CONTINUE
      WRITE(6,1053)
 1053 FORMAT(1H0 50X,23HMINIMUMS IN ALPHA PRIME/40X,4HTIME,9X,1HZ,12X,
     13HSMF,6X,11HALPHA PRIME)
C
      DO 53 J=1,IKMIN
      ALMIN(J)=57.29578D0*ALMIN(J)
      WRITE(6,1052)TAMIN(J),ZMIN(J),FMIN(J),ALMIN(J)
   53 CONTINUE
      RETURN
      END
```

```
CROSBRK
      SUBROUTINE ROSBRK
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON OCCUR, NOCCUR
      COMMON/BLKO/HH(1600),P(40),D(40),E(40),DP(40),A(40),
     1 B(40),GS,GSP,GTP,GSS,GTT,GSB,FZZ,FP,FB,FO,Z,PZZ,TD,RS,SL,ZZZ,
     1OZZ,AXX,EL,
     2DELXX,FAK,CXX(40,10)
      COMMON/DOPT/EO(20)
      COMMON/END/ITERM
      COMMON/IOPT/IPROC,NMAX,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      DIMENSION C(20,20)
      DIMENSION OCCUR(4000), NOCCUR(30)
      EQUIVALENCE (HH(401),C(1))
      EQUIVALENCE (XCOM(1),ALPHA)
      EQUIVALENCE (XCOM(2),BETA)
      EQUIVALENCE (XCOM(3),GAMMA)
      EQUIVALENCE (XCOM(4),DEL)
      EQUIVALENCE (XCOM(5),RATU)
      EQUIVALENCE (XCOM(6),TOL)
C
C
C          SUBROUTINE ROSBRK ATTEMPTS TO MINIMIZE THE VALUE OF A FUNC-
C        TION U( P1,P2,...,P(NMAX) ) WHERE THE P'S ARE ADJUSTABLE
C        DESIGN PARAMETERS BY THE ROSENBROCK ROTATING COORDINATE MINI-
C        MIZATION TECHNIQUE.
C
C     NMAX IS THE NUMBER OF PARAMETERS TO BE ADJUSTED. ITS MAXIMUM
C     VALUE IS 20.
C
C
      NTRIA = 0
      NSTAG = 0
      INDEX = 0
C
  123 CALL FEV(NMAX,P,U)
      IF(ITERM.NE.0) GO TO 600
C
      IF(NTRIA.LE.LIMIT) GO TO 610
      WRITE(6,611)
  611 FORMAT(1HO 34HNTRIA GREATER THAN LIMIT IN ROSBRK)
      ITERM = 1
      GO TO 120
  610 INDEX = INDEX&1
C
      IF(NTRIA.NE.0) GO TO 103
C
      ULAST = U
      USTAG = U
      UPREV = U
      NSUCC = 0
      NTRIA = 1
      DO 104 I=1,NMAX
  104 E(I) = EO(I)
C
C  C  MATRIX IS SET TO A UNIT MATRIX
C
      DO 105 I=1,NMAX
```

```
      DO 105 J=1,NMAX
      IF(I-J) 106,107,106
  106 C(I,J) = 0.D0
      GO TO 105
  107 C(I,J) = 1.D0
  105 CONTINUE
      N=1
      D(1) = 0.D0
      GO TO 108
C
C  SECOND AND SUBSEQUENT TRIALS START HERE
C
C
  103 NTRIA = NTRIA & 1
      IF(U-ULAST*(1.D0&TOL)) 109,109,110
C
C  IF TRIAL WAS A SUCCESS,START HERE
C
  109 ULAST = U
      NSUCC = NSUCC & 1
      D(N) = D(N) & E(N)
      IF(NSUCC.GE.20) GO TO 50
      E(N) = ALPHA*E(N)
      GO TO 108
C
C     IF TRIAL WAS A FAILURE,START HERE
  110 CONTINUE
      WRITE(6,306)NTRIA,N,NSTAG,NSUCC,U,NMAX,(P(I),I=1,NMAX)
 306  FORMAT(1H024H NTRIA     N NSTAG NSUCC19X1HU/ 1H 4I6,F20.10/1H
     1            13HP(I) I = 1 TO 13/(1H 6F20.10))
      DO 111 I=1,NMAX
  111 P(I) = P(I) - DP(I)
      U = ULAST
      IF(NSUCC) 112,112,113
  112 E(N) = -BETA*E(N)
      GO TO 125
 50   WRITE(6,922) NSUCC
 922  FORMAT(1H0 15HWARNING-NSUCC= I6,1X 22HGOING TO NEXT VARIABLE)
C
C     SEARCH IN ONE DIRECTION
C
  113 E(N) = GAMMA*D(N)
C IF N = NMAX, THIS STAGE IS COMPLETE.
      IF(N.EQ.NMAX)GO TO 115
      N=N&1
      D(N) = 0.D0
      NSUCC = 0
      GO TO 125
C
C         STOPPING CRITERIA IS APPLIED AFTER 2ND AND SUBSEQUENT STAGES
C
  115 IF(NSTAG) 116,116,117
  117 ULIM = UPREV - DEL*UPREV
      IF((UPREV-USTAG).EQ.0.D0) GO TO 121
      URAT = (USTAG-ULAST)/(UPREV-USTAG)
      IF(ULAST - ULIM)121,121,118
  118 IF(USTAG - ULIM)121,121,119
  119 IF(URAT - RATO)120,121,121
C
  120 WRITE(6,301)
```

```
301    FORMAT(1HO 26HROSBRK SEARCH IS COMPLETE.)                        ROSBR120
       WRITE(6,302) ULAST,(P(I),I=1,NMAX)                               ROSBR121
 302  FORMAT(1HO37HFINAL PERFORMANCE FUNCTION.  ULAST = E20.10/1H       ROSBR122
     120HFINAL PARAMETERS ARE /(1H 6E20.10))                            ROSBR123
      WRITE(6,303)NTRIA,NSTAG                                           ROSBR124
 303  FORMAT(1HO18HNUMBER OF TRIALS = 15/1H 18HNUMBER OF STAGES = 15)   ROSBR125
      GO TO 600                                                         ROSBR126
C                                                                       ROSBR127
C SEARCH IS COMPLETE                                                    ROSBR128
C                                                                       ROSBR129
C                                                                       ROSBR130
C SEARCH WILL CONTINUE IN A NEW COORDINATE SYSTEM.                      ROSBR131
  121 UPREV = USTAG                                                     ROSBR132
  116 USTAG = ULAST                                                     ROSBR133
      NSTAG = NSTAG&1                                                   ROSBR134
C                                                                       ROSBR135
C DEFINE NEW COORDINATE SYSTEM.                                         ROSBR136
      CALL GRAM                                                         ROSBR137
      WRITE(6,304)                                                      ROSBR138
 304  FORMAT(1HO 20HC MATRIX FROM ROSBRK/  )                            ROSBR139
      DO 200 I=1,NMAX                                                   ROSBR140
  200 WRITE(6,305) (C(I,J),J=1,NMAX)                                    ROSBR141
  305 FORMAT(12(1X,1PE9.2))                                             ROSBR142
  129 N=1                                                               ROSBR143
      D(1)= 0.D0                                                        ROSBR144
      NSUCC=0                                                           ROSBR145
  108 CONTINUE                                                          ROSBR146
      WRITE(6,306)NTRIA,N,NSTAG,NSUCC,U,NMAX,(P(I),I=1,NMAX)            ROSBR147
C                                                                       ROSBR148
C DEFINE COORDINATES FOR NEXT TRIAL.                                    ROSBR149
  125 DO 122 I=1,NMAX                                                   ROSBR150
      DP(I)=C(I,N)*E(N)                                                 ROSBR151
  122 P(I)=P(I)&DP(I)                                                   ROSBR152
C                                                                       ROSBR153
      WRITE(6,500)(DP(I),I=1,NMAX)                                      ROSBR154
      WRITE(6,501)NMAX,(P(I),I=1,NMAX)                                  ROSBR155
      WRITE(6,503) N,E(N)                                               ROSBR156
500   FORMAT(1HO14HIN ROSBRK DP =/(2H 1P6E20.7))                        ROSBR157
501   FORMAT(1HO13HP(I) I = 1 TO 13/(1H 1P6E20.7))                      ROSBR158
503   FORMAT(1HO 13HIN ROSBRK N = I3,2X6HE(N) =E20.10)                  ROSBR159
      GO TO 123                                                         ROSBR160
600   RETURN                                                            ROSBR161
      END                                                               ROSBR162
```

```
CROTATE
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE ROTATE(DERIV,LP)
C
      REAL*8 MX,MY,MZ
      REAL*8 NUMER1,NUMER2
C
      DIMENSION TABIX(50),TABI(50),TABZ(50),OCCUR(4000),NOCCUR(30),
     1          DERIV(16),XJR(25),XJI(25)
      DIMENSION  XNR(25), XNI(25)
C
      EQUIVALENCE
     1(OCCUR(001),AREF  ),(OCCUR(002),ALPHA ),(OCCUR(003),ALPRIM),
     2(OCCUR(012),CNALP ),(OCCUR(013),CMALP ),(OCCUR(015),CD    ),
     3(OCCUR(020),CMQ   ),(OCCUR(021),D     ),(OCCUR(027),G     ),
     4(OCCUR(042),PI    ),(OCCUR(043),P     ),(OCCUR(044),PHI   ),
     5(OCCUR(045),PSI   ),(OCCUR(050),Q     ),(OCCUR(051),QD    ),
     6(OCCUR(055),RHOINF),(OCCUR(056),RHOINI),
     7(OCCUR(065),SMR   ),(OCCUR(071),THEALP),(OCCUR(075),T     ),
     8(OCCUR(077),TCRIT ),(OCCUR(078),TECON ),(OCCUR(081),SMF   ),
     9(OCCUR(082),V     ),(OCCUR(084),W     ),(OCCUR(090),XBAR  ),
     X(OCCUR(091),Z     )
      EQUIVALENCE
     1(OCCUR(108),ZO    ),(OCCUR(113),THEALO),(OCCUR(122),ALST  ),
     2(OCCUR(130),ALWIG2),(OCCUR(131),ALBARP),(OCCUR(202),CM    ),
     3(OCCUR(203),CN    ),(OCCUR(210),MX    ),(OCCUR(211),MY    ),
     4(OCCUR(212),MZ    ),(OCCUR(221),SINGO ),(OCCUR(229),ALALI ),
     5(OCCUR(237),XUP   ),
     6(OCCUR(894),TABI(1)),(OCCUR(944),TABIX(1)),(OCCUR(994),TABZ(1))
C
      EQUIVALENCE
     1(NOCCUR(04),MAXTAB),(NOCCUR(07),LOPT  )
C
      COMMON OCCUR,NOCCUR
C
C
C
C
C       SUBROUTINE ROTATE CALCULATES THE ANGLE OF ATTACK BY ONE OF
C     TWO METHODS DEPENDING ON THE VALUE OF THE INPUT LOPT.
C     LOPT = 0 IS AN UNCOUPLED THREE DEGREE OF FREEDOM CALCULATION.
C     LOPT = 2 IS A SIMPLIFIED ANGLE OF ATTACK SOLUTION REQUIRING NO
C     INTEGRATION.
C       THE FOLLOWING DERIVATIVES ARE CALCULATED IN THIS SUBROUTINE -
C       DERIV(8)=PSI DOT
C       DERIV(9)=THEALP DOT
C       DERIV(10)=PHI DOT
C       DERIV(11)=Q DOT
C       DERIV(12)=SMR DOT
C       DERIV(13)=P DOT
C
C
C       TESTING LOPT
      IF(LOPT.EQ.0)GO TO 8
C       FOR A NON-ZERO VALUE OF LOPT THE DERIVATIVES ARE ZEROED.
      DO 9 J=8,13
    9 DERIV(J)=0.D0
      IF(LOPT.EQ.2)GO TO 15
      RETURN
```

```
C
C        FOR LOPT=0 USING A THREE DEGREE OF FREEDOM IN ROTATION METHOD
C          WHICH CALCULATES THE DERIVATIVES WITH RESPECT TO TIME OF THE
C          EULER ANGLES - PSI, THETA SUB ALPHA, AND PHI - AND OF THE
C          ANGULAR VELOCITIES - P,Q,SMR.
    8 CONTINUE
C           TRIGONOMETRIC FUNCTIONS OF THE EULER ANGLES.
    3 SINP=SIN(PHI)
      COSP=COS(PHI)
      SINI=SIN(PSI)
      COSI=COS(PSI)
      SINL=SIN(THEALP)
      COSL=COS(THEALP)
C           CALCULATION OF THE DERIVATIVES OF THE EULER ANGLES, WHERE
C        DERIV(8)=PSI DOT, DERIV(9)=THETA SUB ALPHA DOT, DERIV(10)=
C          PHI DOT.
      DERIV(8)=(SMR*COSP&Q*SINP)/COSL
      DERIV(9)=Q*COSP-SMR*SINP
      DERIV(10)=P&DERIV(8)*SINL
      COSLP=COSL*COSI
C           DETERMINATION OF THE ANGLE OF ATTACK FROM THE ARCCOSINE OF
C        THE PRODUCT -  COS(THETA SUB ALPHA)*COS(PSI).
      IF(COSLP.LT.0.D0)GO TO 100
      ALPRIM=ACOSK(COSLP)
      CN=CNALP*ALPRIM
      GO TO 4
  100 WRITE(6,101)
  101 FORMAT(1H0 10X,76HTHE ARGUMENT OF ALPRIM IN SUBROUTINE ROTATE IS N
     1EGATIVE. GOING TO NEXT CASE.)
      LP=6
      RETURN
C
C           MOMENTS OF INERTIA ARE DETERMINED FROM THE INPUT TABLES.
    4 CONTINUE
      LL=-1
        UI=TABLE(Z,TABZ, TABI,MAXTAB,LL)
       UIX=TABLE(Z,TABZ,TABIX,MAXTAB,LL)
      IF(UI.EQ.0.0D0)GO TO 13
      IF(UIX.EQ.0.0D0)GO TO 14
    6 CM=CMALP*ALPRIM
C
C           CALCULATION OF DERIVATIVES OF THE ANGULAR VELOCITIES, WHERE
C        DERIV(11)=Q DOT, DERIV(12)=SMR DOT, AND DERIV(13)=P DOT.
      TEM1=QD*AREF*D/UI
      TEM2=0.D0
      IF(ALPRIM.NE.0.D0)TEM2=CM/SIN(ALPRIM)
      TEM3=SINL*COSI
      TEM4=0.5D0*D*CMQ/V
      TEM5=(UI-UIX)*P/UI
      DERIV(11)=TEM1*(TEM2*(TEM3*COSP&SINI*SINP)&TEM4*Q)&TEM5*SMR&MY/JI
      DERIV(12)=TEM1*(TEM2*(SINI*COSP-TEM3*SINP)&TEM4*SMR)-TEM5*Q&MZ/JI
      DERIV(13)=MX/UIX
C
      IF(XBAR.LT.XUP)GO TO 10
   11 ALPHA=ALPRIM
      RETURN
C
C            IN NON-CONTINUUM FLOW REGIME, PERIOD OF THE CYCLE IS TESTED
C          TO DETERMINE APPROPRIATE ANGLE OF ATTACK FOR USE IN DRAGCO.
   10 IF(T.EQ.0.D0)GO TO 11
```

```
      IF(T.GE.TCRIT)GO TO 11
      IF(T.GE.TECON)GO TO 12
      IF(P.EQ.0.DO)ALPHA=2.DO*ALWIG2/PI
      IF(P.NE.0.DO)ALPHA=0.5DO*(ALWIG2&ALBARP)
      GO TO 12
C
C
C
C         SIMPLIFIED ANGLE OF ATTACK SOLUTION WHICH REQUIRES NO
C        CALCULATION OF DERIVATIVES OR SUBSEQUENT INTEGRATION.
   15 LL=-1
      IF(Z.LE.100.0DO)GO TO 90
      UI=TABLE(Z,TABZ,TABI,MAXTAB,LL)
      IF(UI.EQ.0.0DO)GO TO 13
      BETAZ=-DLOG(RHOIN1/0.076474DO)
      IF(BETAZ.LE.0.0001DO)BETAZ=0.0001DO
      IF(Z.EQ.ZO)CD=0.8
      AK1=AREF*G*Z*(2.0DO*CD-CNALP&CMQ*D*D*W/(UI*G))/
     1(4.0DO*BETAZ*W*DABS(SINGO))
      AK2=AREF*G*Z*Z*((CNALP [illegible])*BETAZ*DABS(SINGO)/Z-CMALP*D*W/(UI*G))/
     1(2.0DO*W*(BETAZ*SINGO)**2)
   17 CONTINUE
      TBAR=-2.0DO*PI*Z/(BETAZ*V*SINGO*DSQRT(AK2*RHOINF))
      IF(TBAR.LE.TECON)GO TO 16
      IF(TBAR.LT.1.0D-10)GO TO 16
C
C         OSCILLATORY SOLUTION FOR CYCLE TIMES, TBAR, GREATER THAN
C        TECON.
      SMF=1.0DO/TBAR
      TEM=2.0DO*DSQRT((AK1&AK2)*RHOINF)
      CALL BESSEL(TEM,0.0DO,1.0D-5,10,XJR,XJI,1)
      CALL NEUMAN(1.0D-5,TEM,0.0DO,10,1.0D1,XNR,XNI,XJR(1),XJI(1),XJR(2)
     1,XJI(2),1)
      IF(Z.NE.ZO)GO TO 2
      DTEMDZ=-0.5DO*TEM*BETAZ/Z
      DENAC2=DTEMDZ*(-XNR(2)*XJR(1)&XJR(2)*XNR(1))
      NUMER1=(XJR(1)*AK1*THEALO*2.3769D-3*BETAZ)/(Z*DEXP(AK1*RHOINF&
     1BETAZ))
      NUMER2=THEALO*DTEMDZ*(-XJR(2))*DEXP(-AK1*RHOINF)
      AC2=(NUMER1-NUMER2)/DENAC2
      AC1=(THEALO*DEXP(-AK1*RHOINF)-AC2*XNR(1))/XJR(1)
      ALALI=DEXP(AK1*RHOINF)/DSQRT(PI*DSQRT(AK2*RHOINF))
    2 CONTINUE
      ALPRIM=DEXP(AK1*RHOINF)*(AC1*XJR(1)&AC2*XNR(1))
      CN=CNALP*ALPRIM
      CM=CMALP*ALPRIM
      ALPHA=ALPRIM
      RETURN
C
C        ENVELOPE ANGLE OF ATTACK CALCULATION FOR TBAR LESS THAN OR
C        EQUAL TO TECON.
   16 ALALO=DEXP(AK1*RHOINF)/DSQRT(PI*DSQRT(AK2*RHOINF))
      IF(Z.EQ.ZO)ALALI=ALALO
      ALPRIM=0.63661DO*THEALO*ALALO
      ALPRIM=ALPRIM/ALALI
      SMF=0.0DO
C
C         IF ANGLE OF ATTACK ENVELOPE VALUE IS LESS THAN OR EQUAL TO
C        ALST, INPUT ALPHA STOP VALUE, THE TRAJECTORY IS SWITCHED OVER
C        TO A PARTICLE TRAJECTORY, LOPT=1, AND ANGLE OF ATTACK IS SET
```

```
C        TO ZERO.
         IF(ALPRIM.GT.ALST)GO TO 92
   90 ALPRIM=0.0D0
      LOPT=1
   92 CONTINUE
      CN=CNALP*ALPRIM
      CM=CMALP*ALPRIM
      ALPHA=ALPRIM
   12 RETURN
   13 WRITE(6,1013)Z
      LP=6
      RETURN
   14 WRITE(6,1014)Z
      LP=6
      RETURN
 1013 FORMAT(1H0 10X,37HRESULT OF TABI LOOKUP IS 0.0D0 FOR Z=E12.5)
 1014 FORMAT(1H0 10X,38HRESULT OF TABIX LOOKUP IS 0.0D0 FOR Z=E12.5)
      END
```

```
CSAVEDV
      IMPLICIT REAL*8(A-H,O-Z)
      SUBROUTINE SAVEDV(K,DVAR,OCCUR)
      DIMENSION DVAR(50),OCCUR(4000)
C
C
C           SUBROUTINE SAVEDV STORES THE VALUES OF OCCUR(133-145),
C          OCCUR(205-209), AND OCCUR(222) IN LOCATIONS DVAR(1-19)
C          RESPECTIVELY AND LATER RESTORES THESE VALUES TO THE OCCUR
C          ARRAY.
C
C
      K = K
      GO TO (100,200), K
100   DO 111 I = 1, 13
111   DVAR(I) = OCCUR(I&132)
      DO 112 I = 14, 18
112   DVAR(I) = OCCUR(I&191)
      DVAR(19) = OCCUR(222)
      RETURN
200   DO 222 I = 1, 13
222   OCCUR(I&132) = DVAR(I)
      DO 223 I = 14, 18
223   OCCUR(I&191) = DVAR(I)
      OCCUR(222) = DVAR(19)
      RETURN
      END
```

```
CSCREEN
      SUBROUTINE SCREEN(N,X,ISUC,VAL,D)
      IMPLICIT REAL*8(A-H,O-Z)
      REAL*8 LA1,LA2,LA1F,LAMDA1,LAMDA2,LAMD1F
      COMMON OCCUR,NOCCUR
      COMMON/MULT/SMULT(25)
      DIMENSION PENLTY(25),                    A(25),OCCUR(4000),
     1NOCCUR(30)
      EQUIVALENCE (OCCUR(42),PI),(OCCUR(102),TO),(OCCUR(108),ZO),
     1(OCCUR(121),ZST),(OCCUR(123),TST),(NOCCUR(15),NGEOM),
     2(NOCCUR(22),NTHRST)
      EQUIVALENCE
     1(OCCUR(170),W1F),(OCCUR(150),THET1F),(OCCUR(169),RN1F),
     2(OCCUR(147),RB1F),(OCCUR(151),LAMD1F),(OCCUR(146),LA1F)
      REAL*8DLL(25)/4*0.D0,2*3.D0,2*4.D0,-10.D0,14*0.D0/
      EQUIVALENCE
     1(OCCUR(133),W1    ),(OCCUR(134),THETA1),(OCCUR(135),RN1    ),
     2(OCCUR(136),RB1   ),(OCCUR(137),LAMDA1),(OCCUR(138),LA1    ),
     3(OCCUR(139),W2    ),(OCCUR(140),THETA2),(OCCUR(141),RN2    ),
     4(OCCUR(142),RB2   ),(OCCUR(143),LAMDA2),(OCCUR(144),LA2    ),
     5(OCCUR(145),ZTURN)
      EQUIVALENCE(OCCUR(222),ISP)
      EQUIVALENCE
     3(OCCUR(205),ZON   ),(OCCUR(206),ZOFF  ),(OCCUR(207),THO    ),
     4(OCCUR(208),TON   ),(OCCUR(209),TOFF  ),(OCCUR(210),MX     )
      REAL*8DUL(25)/2*10000.D0,2*.6D0,2*168.D0,40.D0,40.D0,17*0.D0/
      REAL*4M(25)/135,141,137,143,138,144,134,140,145,139,222,205,208,
     1206,209,10*1/
C
C
C        SUBROUTINE SCREEN TESTS THE VALUES OF UP TO TWENTY-FIVE
C        ELEMENTS OF THE OCCUR ARRAY TO DETERMINE WHETHER THESE VALUES
C        LIE WITHIN PRESCRIBED LIMITS.  IF ANY VALUES LIE OUTSIDE THE
C        PRESCRIBED LIMITS, A QUANTITY E IS CALCULATED AS A MEASURE OF
C        ERROR.
C
C
      DO 2 I = 1,25
      PENLTY(I)=0.D0
    2 A(I)=0.D0
      A(1)=1.D0
      A(3)=1.D0
      A(5)=1.D0
      A(7)=1.D0
      A(9)=1.D0
      DLL(12)=ZOFF
      DLL(13)=TO
      DLL(14)=ZST
      DLL(15)=TON
      DUL(9)=ZO
      DUL(10)=W1
      DUL(11)=10000.D0
      DUL(12)=ZO
      DUL(13)=TOFF
      DUL(14)=ZON
      DUL(15)=TST
      IF(ZTURN.LT.0.D0)GO TO 10
      DO 8 I= 2,10,2
    8 A(I)=1.D0
```

```
 10   IF(NTHRST.EQ.0)GO TO 15                                           SCREE 60
      A(11)=1.D0                                                        SCREE 61
      IF(NTHRST.EQ.2)GO TO 12                                           SCREE 62
        A(12)=1.D0                                                      SCREE 63
        A(14)=1.D0                                                      SCREE 64
      GO TO 15                                                          SCREE 65
 12   A(13) = 1.0D0                                                     SCREE 66
        A(15)=1.D0                                                      SCREE 67
C                                                                       SCREE 68
C                                                                       SCREE 69
C                                                                       SCREE 70
 15   IF(NGEOM-2) 18, 20, 40                                            SCREE 71
 18   LAMDA1 = RN1/RB1                                                  SCREE 72
      IF(ZTURN.GE.0.D0) LAMDA2 = RN2/RB2                                SCREE 73
      GO TO 25                                                          SCREE 74
 20   RN1 = LAMDA1*RB1                                                  SCREE 75
 25   IF(ZTURN.LT.0.D0)GO TO 30                                         SCREE 76
      RN2=LAMDA2*RB2                                                    SCREE 77
      TR=0.01745329D0*THETA2                                            SCREE 78
      ST2=DSIN(TR)                                                      SCREE 79
      CT2=DCOS(TR)                                                      SCREE 80
      LA2=(RN2*ST2-RN2&RB2*CT2)/ST2                                     SCREE 81
 30   TR=0.01745329D0*THETA1                                            SCREE 82
      ST1=DSIN(TR)                                                      SCREE 83
      CT1=DCOS(TR)                                                      SCREE 84
      LA1=(RN1*ST1-RN1&RB1*CT1)/ST1                                     SCREE 85
      GO TO 200                                                         SCREE 86
 40   LAMDA1 = RN1/RB1                                                  SCREE 87
      TEM=LA1-RN1                                                       SCREE 88
      TEST=TEM*TEM-RN1*RN1&RB1*RB1                                      SCREE 89
      IF(TEST.LT.0.0D0)GO TO 50                                         SCREE 90
      THETA1=180.D0*ASINR((-(LA1-RN1)*RN1&RB1*DSQRT(TEST))/(TEST&RN1*RN1SCREE 91
     1))/PI                                                             SCREE 92
      GO TO 60                                                          SCREE 93
 50   THETA1=0.D0                                                       SCREE 94
 60   IF(ZTURN.LT.0.D0)GO TO 200                                        SCREE 95
      LAMDA2 = RN2/RB2                                                  SCREE 96
      TEM=LA2-RN2                                                       SCREE 97
      TEST=TEM*TEM-RN2*RN2&RB2*RB2                                      SCREE 98
      IF(TEST.LT.0.D0)GO TO 70                                          SCREE 99
      THETA2=180.D0*ASINR((-(LA2-RN2)*RN2&RB2*DSQRT(TEST))/(TEST&RN2*RN2SCREE100
     1))/PI                                                             SCREE101
      GO TO 200                                                         SCREE102
 70   THETA2=0.D0                                                       SCREE103
C                                                                       SCREE104
C                                                                       SCREE105
C                                                                       SCREE106
 200  E=0.D0                                                            SCREE107
      DO 500 I=1,25                                                     SCREE108
      IZ=M(I)                                                           SCREE109
      IF(OCCUR(IZ).GT.DLL(I))GO TO 250                                  SCREE110
      PENLTY(I)=A(I)*SMULT(I)*DABS(OCCUR(IZ)-DLL(I))**2                 SCREE111
      GO TO 500                                                         SCREE112
 250  IF(OCCUR(IZ).LT.DUL(I))GO TO 500                                  SCREE113
      PENLTY(I)=A(I)*SMULT(I)*DABS(OCCUR(IZ)-DUL(I))**2                 SCREE114
 500  E=E&PENLTY(I)                                                     SCREE115
C                                                                       SCREE116
C                                                                       SCREE117
      IF(E.NE.0.D0)GO TO 600                                            SCREE118
      ISUC=0                                                            SCREE119
```

```
      GO TO 700
C
  600 ISUC=-1
      WRITE(6,450)PI,TO,ZO,ZST,TST,NGEOM,NTHRST,W1F,THET1F,RN1F,RB1F,
     1LAMD1F,LA1F,W1,THETA1,RN1,RB1,LAMDA1,LA1,W2,THETA2,RN2,RB2,LAMDA2,
     2LA2,ZTURN,ISP,ZON,ZOFF,THO,TON,TOFF,(PENLTY(I),I=1,25)
      VAL=E&D
C
  700 CONTINUE
C
      RETURN
C
  450 FORMAT(1H1 13X'PI',13X'TO',13X'ZO',12X'ZST',12X'TST',10X'NGEOM',
     1 9X'NTHRST',12X'W1F'/1H 1P5E15.7,2I15,E15.7/
     21H0 9X'THET1F',11X'RN1F',11X'RB1F', 9X'LAMD1F',11X'LA1F',13X'W1',
     3 9X'THETA1',12X'RN1'/1H 1P8E15.7/
     41H0 12X'RB1', 9X'LAMDA1',12X'LA1',13X'W2', 9X'THETA2',12X'RN2',
     512X'RB2', 9X'LAMDA2'/1H 1P8E15.7/
     61H0 12X'LA2',10X'ZTURN',12X'ISP',12X'ZON',11X'ZOFF',12X'THO',
     712X'TON',11X'TOFF'/1H 1P8E15.7/1H0'PENLTY(I),I=1,25'/
     1(1H 1P8E15.7))
      END
```

```
CSR2490
      SUBROUTINE SR2490
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON OCCUR,NOCCUR
      COMMON /CPCCUR/ PCCUR(11770)
      COMMON /CICCUR/ IOCCUR(320)
      REAL*8 ISP,MW
       DIMENSION A(514), B(21), AA(27), CDOWN(16), CHIGH(16), IOP(90)
       DIMENSION NCOMDV(50), NOCCUR(30 ), OCCUR(4000)
       DIMENSION  NPV(160)
      DIMENSION  TABI1(50),TABI2(50),TABIX1(50),TABIX2(50)
      EQUIVALENCE (OCCUR(301),A(1))
      EQUIVALENCE (OCCUR(122),ALST)
      EQUIVALENCE (OCCUR(823),B(1))
      EQUIVALENCE (OCCUR(115),C)
      EQUIVALENCE (OCCUR(19),CAPG)
      EQUIVALENCE (OCCUR(3549),CDOWN(1))
      EQUIVALENCE (OCCUR(3533),CHIGH(1))
      EQUIVALENCE (OCCUR(187),DELIN)
      EQUIVALENCE (OCCUR(189),FACTR1)
      EQUIVALENCE (OCCUR(27),G)
      EQUIVALENCE (OCCUR(28),GAMMA)
      EQUIVALENCE (OCCUR(222),ISP)
      EQUIVALENCE (OCCUR(4000),LP)
      EQUIVALENCE (OCCUR(117),MW)
      EQUIVALENCE (OCCUR(42),PI)
      EQUIVALENCE (OCCUR(57),R)
      EQUIVALENCE (OCCUR(63),RE)
      EQUIVALENCE (OCCUR(116),SIG)
      EQUIVALENCE (OCCUR(3033),TABIX1(1))
      EQUIVALENCE (OCCUR(3083),TABIX2(1))
      EQUIVALENCE (OCCUR(2933),TABI1(1))
      EQUIVALENCE (OCCUR(2983),TABI2(1))
      EQUIVALENCE (OCCUR(78),TECON)
      EQUIVALENCE (OCCUR(132),TINIT)
      EQUIVALENCE (OCCUR(123),TST)
      EQUIVALENCE (OCCUR(148),TWST)
      EQUIVALENCE (OCCUR(149),TW1)
      EQUIVALENCE (OCCUR(168),TW2)
      EQUIVALENCE (OCCUR(236),XLOW )
      EQUIVALENCE (OCCUR(237),XUP  )
      EQUIVALENCE (OCCUR(240),X1LOW)
      EQUIVALENCE (OCCUR(239),X1UP )
      EQUIVALENCE (OCCUR(120),ZBAR)
      EQUIVALENCE (OCCUR(93),ZETA)
      EQUIVALENCE (OCCUR(118), ZPR1)
      EQUIVALENCE (OCCUR(145),ZTURN)
      EQUIVALENCE (NOCCUR(7),LUPT)
      EQUIVALENCE (NOCCUR(20),MATLN1)
      EQUIVALENCE (NOCCUR(21),MATLN2)
      EQUIVALENCE (NOCCUR(16),MXTAB1)
      EQUIVALENCE (NOCCUR(17),MXTAB2)
      EQUIVALENCE (NOCCUR(15),NGEOM)
      EQUIVALENCE (NOCCUR(14),NPRINT)
      EQUIVALENCE (NOCCUR(22),NTHRST)
      EQUIVALENCE (PCCUR(11571), AA    )
      EQUIVALENCE (IOCCUR(309), IMPLOT)
      EQUIVALENCE (IOCCUR(00001), IOP    )
      EQUIVALENCE (IOCCUR(00301), IREF   )
```

```
      EQUIVALENCE (IOCCUR(00302), LPLOT )
      EQUIVALENCE (IOCCUR(00304), NCP   )
      EQUIVALENCE (IOCCUR(00091), NCOMDV)
      EQUIVALENCE (IOCCUR(00305), NDECOY)
      EQUIVALENCE(IOCCUR(003C6), NDVCH )
      EQUIVALENCE(IOCCUR(000307), NPA   )
      EQUIVALENCE (IOCCUR(00141), NPV   )
C
C
C          SUBROUTINE SR2490 PRESETS THE VALUES OF MANY OF THE INPUT
C        VARIABLES.
C
C
      DO 11 I = 1, 4000
      OCCUR(I) = 0.D0
11    CONTINUE
C
       DO 88 I = 1, 11770
       PCCUR(I) = 0.D00
88     CONTINUE
C
      DO 44 I = 1, 30
      NOCCUR(I) = 0
44    CONTINUE
C
       DO 66 I = 1,320
       IOCCUR(I) = 0
66     CONTINUE
C
C
C
      ALST=0.2D0
      C=1.D0
      CAPG=32.2185D0
      DELIN=-2000.D0
      FACTR1=0.002375D0**0.8D0
      G=32.174D0
      GAMMA=1.4D0
      IMPLOT = 0
      IREF = 1
      ISP=1.0D0
      LOPT=1
      LP = 1
      LPLOT = 1
      MATLN1=1
      MATLN2=1
      MW=28.9D0
      MXTAB1=1
      MXTAB2=1
      NCP = 1
      NDECOY = 1
      NDVCH = 1
      NGEOM=1
      NPA = 1
      NPRINT=1
      PI = 3.14159265358979D0
      R=53.5D0
      RE=2.090229D607
      SIG=3.5D0
      TABIX1(1)=1.0D0
```

```
      TABIX2(1)=1.0D0                                                   SR249120
      TABI1(1)=1.0D0                                                    SR249121
      TABI2(1)=1.0D0                                                    SR249122
      TECON=2.0D0                                                       SR249123
      TINIT=500.0D0                                                     SR249124
      TST=100.0D0                                                       SR249125
      TWST=580.0D0                                                      SR249126
      TW1=1200.0D0                                                      SR249127
      TW2=1200.0D0                                                      SR249128
      XLOW=4.0D0                                                        SR249129
      XUP=6.0D0                                                         SR249130
      XILOW=0.2D0                                                       SR249131
      XIUP=0.4D0                                                        SR249132
      ZBAR=-10000.0D0                                                   SR249133
      ZETA=0.9D0                                                        SR249134
      ZPRI=10000.0D0                                                    SR249135
      ZTURN = -1.D0                                                     SR249136
C                                                                       SR249137
      DO 22 I = 1, 160                                                  SR249138
      NPV(I) = 1                                                        SR249139
22    CONTINUE                                                          SR249140
C                                                                       SR249141
      DO 33 I = 1, 50                                                   SR249142
      NCOMOV(I) = 133                                                   SR249143
33    CONTINUE                                                          SR249144
C                                                                       SR249145
       DO 99  I = 1, 90                                                 SR249146
       IOP(I) = 1                                                       SR249147
99     CONTINUE                                                         SR249148
C                                                                       SR249149
      DO 4 J=1,16                                                       SR249150
      CHIGH(J)=1.0D-4                                                   SR249151
    4 CDOWN(J)=1.0D-5                                                   SR249152
C                                                                       SR249153
       DO 77 I = 3, 27, 3                                               SR249154
      AA(I) = 1.D0                                                      SR249155
77    CONTINUE                                                          SR249156
C                                                                       SR249157
      CALL ZPRS(A,B)                                                    SR249158
C                                                                       SR249159
      RETURN                                                            SR249160
C                                                                       SR249161
      END                                                               SR249162
```

```
CSTUFF
      SUBROUTINE STUFF
        IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/BLKO/ H(40,40),X(40),G(40),S(40),XP(40),GP(40),T(40),GB(40)
     1,GS, GSP, GTP,GSS, GTT, GSB,F,FP,FB,FO,E, P,TO,RS,SL, Z,D,A,EL,
     2DELTA,FAC,C(40,10)
      COMMON/BLKI/M,N,L,LS,M1,MS,NS,IT,K,NC
C
C
C           SUBROUTINE STUFF, PART OF THE DAVIDON MINIMIZATION METHOD,
C         TESTS HOW WELL THE FUNCTION HAS BEEN MINIMIZED AND HOW WELL
C         THE MATRIX H APPROXIMATES THE INVERSE OF THE MATRIX OF SECOND
C         PARTIAL DERIVATIVES AT THE MINIMUM.
C
C
C     STUFF
  600 K=K-1
  601 IF (K)617,602,602
  602 MS=MS&1
  620 WRITE (6,1)MS,GS
  603 DO 604 I=1,N
C
C
  604 T(I)=RANDOM(DUMMY)-0.5
C
  605 CALL MATMP (N,N,H,T,S)
  606 M=1
  607 CALL MATMP (M,N,S,T,TP1)
  608 TP1 = DSQRT(TP1)
  609 EL=P/TP1
  610 DO 611 I=1,N
  611 X(I)=X(I)&EL*S(I)
  612 M1=2
  614 L=1
  616 RETURN
  617 L=2
  618 MS=0
  619 GO TO 616
    1 FORMAT (13HORANDOM STEP I4,5H  GS=1PE14.5)
      END
```

```
CTABLE
      IMPLICIT REAL*8 (A-H,O-Z)
      FUNCTION TABLE(X,XTAB,YTAB,KMAX,L)
      DIMENSION XTAB(2),YTAB(2)
C
C         FUNCTION TABLE PERFORMS A ONE DIMENSIONAL TABLE LOOK UP
C     USING LINEAR INTERPOLATION.
C
      IF(KMAX.EQ.1)GO TO 6
      IF(L.GT.0)GO TO 2
      IGO=1
      IF(XTAB(1).GT.XTAB(2))IGO=2
C
      DO 1 K=2,KMAX
      GO TO(3,4),IGO
    3 IF(X.GT.XTAB(K))GO TO 1
      GO TO 5
    4 IF(X.LT.XTAB(K))GO TO 1
    5 L=K
      GO TO 2
    1 CONTINUE
C
      L=KMAX
    2 ANS=YTAB(L-1)+(X-XTAB(L-1))*(YTAB(L)-YTAB(L-1))/
     1(XTAB(L)-XTAB(L-1))
      TABLE=ANS
      RETURN
C
    6 TABLE=YTAB(1)
      RETURN
      END
```

```
CTEQUAT
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE TEQUAT(DERIV)
C
      REAL*8 ISP,M
C
      DIMENSION DERIV(16),CMAT(3,3),TTMAT(3),TBMAT(3),FBMAT(3),FTMAT(3)
      DIMENSION OCCUR(4000),NOCCUR(30)
C
      EQUIVALENCE
     1(OCCUR(001),AREF  ),(OCCUR(016),CD     ),(OCCUR(019),CAPG  ),
     2(OCCUR(026),GAME  ),(OCCUR(037),M      ),(OCCUR(051),QD    ),
     3(OCCUR(063),RE    ),(OCCUR(082),V      ),(OCCUR(091),Z)
      EQUIVALENCE
     1(OCCUR(003),ALPRIM),(OCCUR(044),PHI    ),(OCCUR(045),PSI   ),
     2(OCCUR(071),THEALP),(OCCUR(200),PSIALP),(OCCUR(203),CN    ),
     3(OCCUR(213),THINE ),(OCCUR(222),ISP    ),
     4(OCCUR(3565),TTMAT(1)),(OCCUR(3643),TBMAT(1))
C
      COMMON OCCUR,NOCCUR
C
C
C
C           SUBROUTINE TEQUAT CALCULATES THE DERIVATIVES OF THE PARTICLE
C         TRAJECTORY AND THRUSTING PARAMETERS.
C           THE FOLLOWING DERIVATIVES ARE CALCULATED IN THIS SUBROUTINE -
C           DERIV(1)=V DOT
C           DERIV(2)=GAME DOT
C           DERIV(3)=D(TIME)/D(ALTITUDE)
C           DERIV(4)=XR DOT
C           DERIV(14)=YR DOT
C           DERIV(15)=PSIALP DOT
C           DERIV(16)=WTH DOT
C
C
C           TRIGONOMETRIC FUNCTIONS OF THE EULER ANGLES.
      CTHEL=COS(THEALP)
      STHEL=SIN(THEALP)
      CPSI=COS(PSI)
      SPSI=SIN(PSI)
      CPHI=COS(PHI)
      SPHI=SIN(PHI)
C
C           COMPONENTS OF THE CONVERSION MATRIX WHICH TRANSFORMS FROM A
C         BODY ORIENTED TO A TRAJECTORY ORIENTED COORDINATE SYSTEM.
      CMAT(1,1)=CTHEL*CPSI
      CMAT(2,1)=CTHEL*SPSI
      CMAT(3,1)=-STHEL
      CMAT(1,2)=CPSI*STHEL*SPHI-SPSI*CPHI
      CMAT(2,2)=SPSI*STHEL*SPHI+CPSI*CPHI
      CMAT(3,2)=CTHEL*SPHI
      CMAT(1,3)=CPSI*STHEL*CPHI+SPSI*SPHI
      CMAT(2,3)=SPSI*STHEL*CPHI-CPSI*SPHI
      CMAT(3,3)=CTHEL*CPHI
C
C           RESOLVING THE THRUST VECTOR INTO TRAJECTORY COORDINATES.
      CALL MATMPY(TTMAT,CMAT,TBMAT)
      XRDOT=V*CMAT(1,1)
      YRDOT=V*CMAT(1,2)
```

```
      ZBDOT=V*CMAT(1,3)
C
C              NORMAL FORCE CALCULATION.
      FN=CN*QD*AREF
C              AXIAL FORCE COEFFICIENT.
      CX=(-CD&CN*SIN(ALPRIM))/COS(ALPRIM)
C
C              CALCULATION OF BODY FORCES.
      FBMAT(1)=QD*AREF*CX
      ROOT=SQRT(YBDOT**2&ZBDOT**2)
      IF(ROOT.LT.1.0D-10)GO TO 1
      FBMAT(2)=-FN*YBDOT/ROOT
      FBMAT(3)=-FN*ZBDOT/ROOT
      GO TO 2
    1 FBMAT(2)=0.0D0
      FBMAT(3)=0.0D0
C              RESOLVING THE BODY FORCES INTO TRAJECTORY COORDINATE SYSTEM.
    2 CALL MATMPY(FTMAT,CMAT,FBMAT)
C
C              CALCULATION OF DERIVATIVES.
      TEM=RE/(RE&Z)
      TEM2=CAPG*TEM*TEM
      SING=SIN(GAME)
      COSG=COS(GAME)
      DERIV(1)=-QD*CD*AREF/M-TEM2*SING&TTMAT(1)/M
      DERIV(2)=COSG*(V*V*TEM/RE-TEM2)/V-(FTMAT(3)&TTMAT(3))/(M*V)
      DERIV(3)=V*SING
      DERIV(4)=COS(PSIALP)*V*COSG*TEM
      DERIV(14)=SIN(PSIALP)*V*COSG*TEM
      DERIV(15)=-(FTMAT(2)&TTMAT(2))/(M*V*COSG)
      DERIV(16)=-THINT/ISP
      DERIV(3)=1.0D0/DERIV(3)
      RETURN
      END
```

```
CTIMERS
      IMPLICIT REAL*8(A-H,O-Z)
      SUBROUTINE TIMERS(N,TABLE)
      DIMENSION TABLE(2)
C
C
C         SUBROUTINE TIMERS IS A DUMMY SUBROUTINE.
C
C
      RETURN
      END
```

```
CTOMALO
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE TOMALO

      REAL*8 LAMDA,LA,MDOT,MC,MT,MN

      DIMENSION OCCUR(4000),NOCCUR(30),MDOT(4,8),XLA(8)
      DIMENSION MC(6)
C
      EQUIVALENCE
     1(OCCUR(008),COST  ),(OCCUR(032),LAMDA ),(OCCUR(033),LA    ),
     2(OCCUR(042),PI    ),(OCCUR(052),RN    ),(OCCUR(064),SINT  ),
     3(OCCUR(070),TANT  ),(OCCUR(086),WDOT  ),(OCCUR(091),Z     ),
     4(OCCUR(092),ZTR   ),(OCCUR(0815),XLA(1)),(OCCUR(2708),MDOT(1,1))
C
      COMMON OCCUR,NOCCUR
C
C
C
C
C           SUBROUTINE TOMALO INTEGRATES THE MASS LOSS RATE ALONG THE
C       BODY TO OBTAIN THE RATE OF CHANGE IN WEIGHT DUE TO ABLATION.
C
C           INTEGRATION ALONG SHARP CONE FOR LAMINAR FLOW.
      IF(LAMDA.GT.1.0D-3)GO TO 2
      IF(Z.GE.ZTR)MT=2.0618D0*SQRT(2.0D0)*TANT*MDOT(2,8)*LA**2/COST
C
C           INTEGRATION ALONG SHARP CONE FOR TURBULENT FLOW.
      IF(Z.LT.ZTR)MT=3.04D0*((2.0D0)**0.2D0)*TANT*MDOT(3,8)*LA**2/COST
      GO TO 3
C
    2 TEM=PI*LA *LA /(COST*COST)
      TEM1=RN*(1.D0-SINT)/LA
      TEM2=0.5D0*SINT
      TEM3=(.766D0-SINT)/.234D0
C
C           BLUNT CONE LAMINAR MASS LOSS INTEGRATION.
      IF(Z.LT.ZTR)GO TO 4
C           INTEGRATION AROUND THE NOSECAP.
      MN=PI*RN*(1.D0-SINT)*(MDOT(1,1)&MDOT(2,1))*RN
C           INTEGRATION ALONG CONICAL FRUSTUM USING TRAPEZOIDAL RULE.
      DO 5 I=1,6
      MC(I)=TEM*(XLA(I&1)-XLA(I))*(TEM1&TEM2*(XLA(I&1)&XLA(I)))
    5 MC(I)=MC(I)*(MDOT(2,I)&MDOT(2,I&1))
      GO TO 7
C
C
C           BLUNT CONE TURBULENT MASS LOSS INTEGRATION.
C           INTEGRATION AROUND THE NOSECAP.
    4 MN=0.7851D0*RN*RN*(MDOT(1,1)&MDOT(4,1)&(MDOT(4,1)&MDOT(3,1))
     1*TEM3)
C           INTEGRATION ALONG CONICAL FRUSTUM USING TRAPEZOIDAL RULE.
      DO 6 I=1,6
      MC(I)=TEM*(XLA(I&1)-XLA(I))*(TEM1&TEM2*(XLA(I&1)&XLA(I)))
    6 MC(I)=MC(I)*(MDOT(3,I)&MDOT(3,I&1))
C
C
C           SUMMATION OF CONTRIBUTIONS FROM NOSECAP AND CONICAL FRUSTUM.
    7 MT=MN
```

```
      DO 8 I=1,4                                                        TOMAL 60
    8 MT=MT+MC(I)                                                       TOMAL 61
    9 WDOT= MT                                                          TOMAL 62
      RETURN                                                            TOMAL 63
      END                                                               TOMAL 64
```

```
CVIXEN
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE VIXEN
C
      REAL*4       TIXM,TIXT,TIXZ,T1,T2,T3,T4,
     1T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,T18,T19,T20,T21,T22
      REAL * 4  T23, T24, T25, T26, T27, T28
      REAL*8 LAMDA,LA,MINF,MDOT,LAMSTO
      COMMON /CPCCUR/ PCCUR(1177C)
      COMMON /CICCUR/ IOCCUR(320)
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      COMMON OCCUR,NOCCUR
C
      DIMENSION  A(514),COFINF(2,2,2,2),QDOT(4,8),MDCT(4,8),PFPSU(8),
     1           OCCUR(4000),NOCCUR(30),COJWN(16),TTMAT(3),TITLE(2),
     2           ALMAX(200),ALMIN(200),TAMAX(200),TAMIN(200),
     3           ZMAX(200), ZMIN(200), FMAX(200), FMIN(200)
      DIMENSION DVALUE(16),DERIV(16),LPBND(16),DNBND(16),CHIGH(16)
      DIMENSION QINT(8),QLAST(8)
      DIMENSION NPLOT(5)
      DIMENSION  WTZ(75),WTMINF(75),WTRINF(75),WTPTOT(75),TRAJT(75),
     1           TRAJZ(75),TRAJV(75),TRAJW(75),TRAJRN(75),TRJALP(75),
     2           ALPTAB(75)
      DIMENSION        TIXM(10),TIXT(10),TIXZ(10),T1(10),T2(10),
     1T3(10),T4(10),T5(10),T6(10),T7(10),T8(10),T9(10),T10(10),T11(10),
     1T12(10),T13(10),T14(10),T15(10),T16(10),T17(10),T18(10),T19(10),
     1T20(10),T21(10),T22(10),
     3 ZPLOT(160), TPLOT(160),PLMINF(160),CDPLOT(160),CDFPLT(160),
     4CDPLT(160),CDIPLT(160),WTOTPL(160),DETAPL(160), VPLOT(160),
     5VCPLT(160), QPLOT(160),PSPLOT(160),HSRTPL(160),CD11PL(160),
     6CD41PL(160),PE1PLT(160),PE7PLT(160),PE8PLT(160),CD7PLT(160),
     7 QB8PLT(160),ALPLOT(160),DCPLOT(160)
      DIMENSION WR1P(160), WR2P(160), WR3P(160)
      DIMENSION  WL1P(160), WL2P(160),WL3P(160)
      DIMENSION T23(10), T24(10), T25(10), T26(10), T27(10), T28(10)
      DIMENSION IOP(50)
C
      EQUIVALENCE
     1(OCCUR(001),APEF   ),(OCCUR(002),ALPHA ),(OCCUR(003),ALPRIM),
     2(OCCUR(010),CAPL   ),(OCCUR(016),CD    ),(OCCUR(020),CMQ    ),
     3(OCCUR(026),GAMF   ),(OCCUR(027),G     )
      EQUIVALENCE
     1(OCCUR(029),HSRTC  ),(OCCUR(032),LAMDA ),(OCCUR(033),LA     ),
     2(OCCUR(035),MINF   ),(OCCUR(042),PI    ),(OCCUR(043),P      ),
     3(OCCUR(044),PHI    ),(OCCUR(045),PSI   ),(OCCUR(047),PS     ),
     4(OCCUR(050),Q      ),(OCCUR(051),QD    ),(OCCUR(052),RN     )
      EQUIVALENCE
     1(OCCUR(062),REYL   ),(OCCUR(065),SMR   ),
     2(OCCUR(069),THETAD ),(OCCUR(071),THEALP),(OCCUR(075),T      ),
     3(OCCUR(076),THETA  ),(OCCUR(080),TIMER ),(OCCUR(081),SMF    )
      EQUIVALENCE
     1(OCCUR(082),V      ),(OCCUR(087),XR    ),
     2(OCCUR(090),XBAR   ),(OCCUR(091),Z     ),(OCCUR(092),ZTK    ),
     3(OCCUR(095),GRATE  ),(OCCUR(096),ALPENV),(OCCUR(097),DELW   ),
     4(OCCUR(098),CDP    ),(OCCUR(099),CDB   ),(OCCUR(100),CD1    ),
     5(OCCUR(101),CDPO   ),(OCCUR(102),TO    ),(OCCUR(105),GAMFO  ),
     6(OCCUR(106),VO     ),(OCCUR(107),XRO   ),(OCCUR(108),ZO     )
      EQUIVALENCE
     1(OCCUR(109),PO     ),(OCCUR(110),QO    ),(OCCUR(111),SMRO   ),
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NOT REPRODUCIBLE

```
2(OCCUR(112),PHIU  ),(OCCUR(113),THEALO),(OCCUR(114),PSIU   ),       VIXFN 60
3(OCCUR(118),ZPR1  ),(OCCUR(119),ZPR2  ),(OCCUR(120),ZBAR   ),       VIXFN 61
4(OCCUR(121),ZST   ),(OCCUR(122),ALST  ),(OCCUR(123),TST    ),       VIXFN 62
5(OCCUR(126),XBAR1 ),                                                VIXFN 63
6(OCCUR(127),DATE  ),(OCCUR(128),CASE  ),(OCCUR(129),EMC    ),       VIXFN 64
7(OCCUR(130),ALWIG2),(OCCUR(131),ALBARP),(OCCUR(133),W1     ),       VIXFN 65
8(OCCUR(107),DELIN )                                                 VIXFN 66
 EQUIVALENCE                                                         VIXFN 67
1(OCCUR(199),YK    ),(OCCUR(200),PSIALP),(OCCUR(201),TH     ),       VIXFN 68
2(OCCUR(202),CM    ),(OCCUR(203),CN    ),(OCCUR(226),DFLW2 )         VIXFN 69
 EQUIVALENCE                                                         VIXFN 70
1(OCCUR(227),DFLW3 ),(OCCUR(228),WTOTAL),(OCCUR(230),BETAP ),        VIXFN 71
2(OCCUR(231),BETA  ),(OCCUR(232),V2GDOT),(OCCUR(233),DOW    ),       VIXFN 72
3(OCCUR(234),DELCDP),(OCCUR(235),DECDFP),(OCCUR(236),DELFFC),        VIXFN 73
4(OCCUR(237),XUP   ),(OCCUR(244),REYINF),                            VIXFN 74
5(OCCUR(245),PTOTAL),(OCCUR(247),UPBNDZ),(OCCUR(248),DNBNDZ)         VIXFN 75
 EQUIVALENCE                                                         VIXFN 76
1(OCCUR(0301),      A(1)),(OCCUR(1044), ALMAX(1)),                   VIXFN 77
2(OCCUR(1244), ALMIN(1)),(OCCUR(1444), TAMAX(1)),                    VIXFN 78
3(OCCUR(1644), TAMIN(1)),(OCCUR(1344),  ZMAX(1)),                    VIXFN 79
4(OCCUR(2044),  ZMIN(1)),(OCCUR(2264),  FMAX(1)),                    VIXFN 80
5(OCCUR(2444),  FMIN(1))                                             VIXFN 81
 EQUIVALENCE                                                         VIXFN 82
1(OCCUR(1044),WTZ(1)    ),(OCCUR(1119),WTMINF(1)),                   VIXFN 83
2(OCCUR(1194),WTRINF(1)),(OCCUR(1269),WTPTCT(1)),                    VIXFN 84
3(OCCUR(1344),TRAJT(1) ),(OCCUR(1419),TRAJZ(1) ),                    VIXFN 85
4(OCCUR(1494),TRAJV(1) ),(OCCUR(1569),TRAJW(1) ),                    VIXFN 86
5(OCCUR(1644),TRAJRN(1)),(OCCUR(1719),TRJALP(1))                     VIXFN 87
 EQUIVALENCE                                                         VIXFN 88
1(OCCUR(2676),QDOT(1,1)),(OCCUR(2709),MDOT(1,1)),                    VIXFN 89
2(OCCUR(2793),COFINF(1,1,1)),(OCCUR(2901),PRPSB(1)),                 VIXFN 90
3(OCCUR(3233),HTAB(1))                                               VIXFN 91
 EQUIVALENCE                                                         VIXFN 92
1(OCCUR(3533), CHIGH(1)),(OCCUR(3549), CDOWN(1)),                    VIXFN 93
2(OCCUR(3565), TTMAT(1)),(OCCUR(3646),ALPTAB(1))                     VIXFN 94
 EQUIVALENCE                                                         VIXFN 95
1(NOCCUR(01),JJHOLD),(NOCCUR(03),MOPT  ),                            VIXFN 96
2(NOCCUR(06),MAXVAL),(NOCCUR(07),LOPT  ),(NOCCUR(10),MHEAT ),        VIXFN 97
X(NOCCUR(11),IKMAX ),(NOCCUR(12),IKMIN ),                            VIXFN 98
3(NOCCUR(14),NPRINT),(NOCCUR(24),NPLOT(1)),(NOCCUR(29),ITAPE),       VIXFN 99
4(NOCCUR(30),INALPH)                                                 VIXFN100
 EQUIVALENCE (NOCCUR(00008), IATMOS)                                 VIXFN101
 EQUIVALENCE(OCCUR(4000),LP)                                         VIXFN102
 EQUIVALENCE (IOCCUR(00001), IOP   )                                 VIXFN103
  EQUIVALENCE (IOCCUR(00314), IOBL  )                                VIXFN104
 EQUIVALENCE (IOCCUR(00302), LPLOT )                                 VIXFN105
 EQUIVALENCE (PCCUR(00641), BETAPL)                                  VIXFN106
 EQUIVALENCE (PCCUR(00001), TPLOT )                                  VIXFN107
 EQUIVALENCE (PCCUR(00481), V2GPLT)                                  VIXFN108
 EQUIVALENCE (PCCUR(00321), VPLOT )                                  VIXFN109
 EQUIVALENCE (PCCUR(01281), WL1P  )                                  VIXFN110
 EQUIVALENCE (PCCUR(01441), WL2P  )                                  VIXFN111
 EQUIVALENCE (PCCUR(01601), WL3P  )                                  VIXFN112
 EQUIVALENCE (PCCUR(00801), WR1P  )                                  VIXFN113
 EQUIVALENCE (PCCUR(00961), WR2P  )                                  VIXFN114
 EQUIVALENCE (PCCUR(01121), WR3P  )                                  VIXFN115
 EQUIVALENCE (PCCUR(00161), ZPLOT )                                  VIXFN116
C                                                                    VIXFN117
C                                                                    VIXFN118
C                                                                    VIXFN119
```

```
C
C       SUBROUTINE VIXEN PERFORMS THE FOLLOWING FUNCTIONS  -
C     SETS INITIAL VALUES OF CERTAIN QUANTITIES.
C     CALLS IN SUBROUTINE CHNTBL, WHICH ASSIGNS APPROPRIATE GEOMETRIC
C     AND MATERIAL PROPERTIES.
C     ASSIGNS THE ACCURACY LIMITS FOR INTEGRATION.
C     CALLS IN THE INTEGRATION SUBROUTINE, ADMRK, FOR THESE OPTIONS
C     WHERE A TRAJECTORY IS BEING CALCULATED,  OR SETS PROGRAM
C     VARIABLES EQUAL TO TABULAR INPUT VALUES OF THE WIND TUNNEL OR
C     INPUT TRAJECTORY OPTIONS, AS WELL AS CALLING IN THE SUBROUTINES
C     WHICH PERFORM CALCULATIONS NECESSARY TO OBTAIN DRAG VALUES
C     WHEN NO INTEGRATION IS DONE.
C     CALCULATES THE MAXIMUMS AND MINIMUMS IN ANGLE OF ATTACK WHEN
C     THE THREE DEGREE OF ROTATIONAL FREEDOM OPTION IS USED.
C     CONTROLS THE PRINTOUT.
C     CALLS IN THE TAPE AND THE PLOTTING SUBROUTINES.
C
C
C
C       TITLES FOR THE PLOTTING OPTIONS
      DATA TITLE(1)/4HTURB/
      DATA TITLE(2)/4H LAM/
      DATA TIXT/40H                   TIME IN SECONDS      /
      DATA TIXZ/40H                  ALTITUDE IN FEET      /
      DATA TIXM/40H                        MINF            /
      DATA  T1/40H                      CD TOTAL          /
      DATA  T2/40H                      CDB & CDP         /
      DATA T3/40H      CDFINF(BLUNT WITH BLOWING)          /
      DATA  T4/40H                         CDI            /
      DATA  T5/40H                  WTOTAL/WI             /
      DATA  T6/40H                    BETA                /
      DATA  T7/40H                 VELOCITY(FT/SEC)       /
      DATA  T8/40H                        MINF            /
      DATA  T9/40H                       VDOT/G           /
      DATA T10/40H                   ALTITUDE(FT)         /
      DATA T11/40H             DYNAMIC PRESSURE(LB/FT2)/
      DATA T12/40H                      PS(ATMOS)         /
      DATA T13/40H                      HSRTC             /
      DATA T14/40H            QDOT(STAG)(BTU/FT2-SEC)     /
      DATA T15/40H            QDOT(SONIC)(BTU/FT2-SEC)    /
      DATA T16/40H               QDOT(7)(BTU/FT2-SEC)     /
      DATA T17/40H               QDOT(8)(BTU/FT2-SEC)     /
      DATA T18/40H                 PEPSB(TANG. PT)        /
      DATA T19/40H                    PEPSB(7)            /
      DATA T20/40H                    PEPSB(8)            /
      DATA T21/40H            ALPHA PRIME ENV(DEGREES)/
      DATA T22/40H                    CCCUR(NPLCT5)       /
      DATA T23/40H            WAKE  L1                    /
      DATA T24/40H            WAKE  L2                    /
      DATA T25/40H            WAKE  L3                    /
      DATA T26/40H            WAKE  R1                    /
      DATA T27/40H            WAKE  R2                    /
      DATA T28/40H            WAKE  R3                    /
C
C
C       SETTING INITIAL VALUES
      NK=0
    1 V=VO
      GAME=GAMEO
      TIME=TO
```

NOT REPRODUCIBLE

```
      Z=ZO
      XR=XRO
      P=PO
      Q=QO
      SMR=SMRO
      PSI=PSIO
      THEALP=THEALO
      PHI=PHIO
      YR=0.D0
      PSIALP=0.D00
      ZUST=Z
      CVALUE(1)=V
      CVALUE(2)=GAMF
      CVALUE(3)=TIME
      CVALUE(4)=XR
      CVALUE(8)=PSI
      CVALUE(9)=THEALP
      CVALUE(10)=PHI
      CVALUE(11)=Q
      CVALUE(12)=SMR
      CVALUE(13)=P
      CVALUE(14)=YR
      CVALUE(15)=PSIALP
      BETA=0.D0
      BETAP=0.D0
      DELBET=0.D0
      T=0.D0
      SMF=0.D00
      ALPRIM=0.D00
      ALPHA=0.D00
      ALPENV=0.D00
      IALP=1
      IKMAX=0
      IKMIN=0
      PRINTZ=0.D0
      ZSTO=0.D0
      DELPR1=ZPR1
      FREQ=-DELPR1
      DEL=-ZPR1/5.D00
      LPLOT=0
      NNTAPE=0
C
C           SELECTION OF DELTA OF INTEGRATION
      IF(DABS(DELIN).LT.DABS(DEL))DEL=DELIN
C
C           SUBROUTINE CHNTOL ASSIGNS THE APPROPRIATE GEOMETRIC PARA-
C        METERS AND MATERIAL PROPERTIES AT ENTRY AND WHEN CONFIGURATION
C        CHANGES AT ALTITUDE ZTURN.
      LCHNGE=1
   60 CALL CHNTOL(DVALUE,ZTURNX,LCHNGE)
      L =1
      IF(JJHOLD.NE.(-1))GO TO 50
      LP=6
      WRITE(6,1005)
      GO TO 100
   50 IF(ZUST.GT.ZTURNX)GO TO 61
      LCHNGE=2
      WRITE(6,1065)Z
 1065 FORMAT(1H0,20X,'CONFIGURATION IS CHANGING DISCONTINUOUSLY AT Z=',
     1E15.6 )
```

```
      GO TO 60
   61 CONTINUE
C
C          ASSIGNING OF BOUNDS ON THE ABSOLUTE DIFFERENCE BETWEEN THE
C       EXTRAPOLATED AND INTERPOLATED VALUES IN THE INTEGRATION
      DO 3 J=1,16
      TEM=ABS(DVALUE(J))
      IF(TEM.LE.1.D0)GO TO 4
      UPBND(J)=CHIGH(J)*TEM
      DNBND(J)=CDOWN(J)*TEM
      GO TO 3
    4 UPBND(J)=CHIGH(J)
      DNBND(J)=CDOWN(J)
    3 CONTINUE
C
      IF(LOPT.LT.3)GO TO 31
      IF(LOPT.EQ.4)GO TO 41
C
C          ASSIGNING TABULAR TRAJECTORY INPUT TO INTERNAL PROGRAM
C       SYMBOLS.
      TIMER=TRAJT(NK&1)
      TIME=TIMER
      TO=TRAJT(1)
      Z=TRAJZ(NK&1)
      V=TRAJV(NK&1)
      IF(V.NE.0.0D0)GO TO 1016
      WRITE(6,1015)
 1015 FORMAT(1H0,10X,'*****WARNING***** CANNOT ACCEPT A ZERO VELOCITY,
     1GOING TO NEXT CASE')
      RETURN
 1016 CONTINUE
      WTOTAL=TRAJW(NK&1)
      RN=TRAJRN(NK&1) /12.0D0
      ALPHA=TRJALP(NK&1) /57.2957800
      ALPHIM=ALPHA
      INALPH=1
      DO 74 KK=1,8
      RDOT(2,KK)=0.0D0
      RDOT(3,KK)=0.0D0
      QDOT(2,KK)=0.0D0
   74 QDOT(3,KK)=0.0D0
      RDOT(1,1)=0.0D0
      RDOT(4,1)=0.0D0
      QDOT(1,1)=0.0D0
      QDOT(4,1)=0.0D0
      GO TO 40
C
C          ASSIGNING TABULAR WIND TUNNEL INPUTS TO INTERNAL PROGRAM
C       SYMBOLS.
   41 CONTINUE
      Z=WTZ(NK&1)
      MINF=WTMINF(NK&1)
      IF(MINF.GE. 5.0D0)GO TO 1046
      WRITE(6,1045)
 1045 FORMAT(1H1,10X,'*****WARNING***** CANNOT ACCEPT A MACH NUMBER LESS
     1 THAN 5.  GOING TO NEXT CASE')
      RETURN
 1046 CONTINUE
      REYINF=WTPINF(NK&1)
      PTOTAL=WTPTOT(NK&1)
```

```
      TIMER=NK
      TIME=TIMER
      T0=0.0D0
      INALPH=1
      DO 72 KK=1,8
      MDOT(2,KK)=0.0D0
      MDOT(3,KK)=0.0D0
      QDOT(2,KK)=0.0D0
   72 QDOT(3,KK)=0.0D0
      MDOT(1,1)=0.0D0
      MDOT(4,1)=0.0D0
      QDOT(1,1)=0.0D0
      QDOT(4,1)=0.0D0
C         INPUT ALPHA TO BE USED WITH WIND TUNNEL CONDITIONS.
      ALPHA=ALPTAB(NK&1)/57.29578DC
      ALPRIM=ALPHA
C
C         WHEN TRAJECTORY INPUT OR WIND TUNNEL INPUT TABLES ARE USED
C      THE INTEGRATION SUBROUTINE IS BYPASSED AND PRELIMINARY
C      CALCULATIONS, AERODYNAMIC HEATING, MASS LOSS, AND DRAG
C      CALCULATIONS ARE DONE FOR THE INPUT ALTITUDES ONLY.
   44 CONTINUE
      LL=1
      CALL PRELIM(LL)
      IF(MINF.LT.5.0D0)WRITE(6,32)
   32 FORMAT(1H0,25X,57H***WARNING*** PROGRAM IS NOT VALID FOR MINF LESS
     1 THAN 5.0)
      IF(MOPT.EQ.0) GO TO 39
      IF(XBAR.GT.XUP)GO TO 39
      CALL AERODY
      IF(MHEAT.EQ.0) GO TO 39
      CALL MASSLO
      CALL TOMALO
   39 CONTINUE
      CALL DRAGCO
      GO TO 101
C
C
C         VARIABLES ARE INTEGRATED AND THE TRAJECTORY CALCULATED WHEN
C      LOPT IS LESS THAN OR EQUAL TO 2.  THE QUANTITIES BEING
C      INTEGRATED IN ADM4RK ARE AS FOLLOWS, WHERE DVALUE IS THE
C      INTEGRATED VALUE AND DERIV IS THE CORRESPONDING DERIVATIVE
C      WITH ALTITUDE.
C         DVALUE(1)=V
C         DVALUE(2)=GAME
C         DVALUE(3)=TIME
C         DVALUE(4)=XR
C         DVALUE(5)=W
C         DVALUE(6)=RN
C         DVALUE(7)=RB
C         DVALUE(8)=PSI
C         DVALUE(9)=THEALP
C         DVALUE(10)=PHI
C         DVALUE(11)=Q
C         DVALUE(12)=SNR
C         DVALUE(13)=P
C         DVALUE(14)=YR
C         DVALUE(15)=PSIALP
C         DVALUE(16)=WTH
   11 CONTINUE
```

```
      CALL ADAMRK(16,DEL,DVALUE,DERIV,UPBND,DNBND,0.3D0,FREQ  ,ZST,LP,
     1ZUSE,1.D0)
C
      FINF=DVALUE(3)
      Z=ZUSE
      IF(LP.NE.6)GO TO 7
      WRITE(6,1005)
 1005 FORMAT(1H0 10X,34HPROGRAM ERROR. GOING TO NEXT CASE.)
      GO TO 100
C
C           FOR THE LOPT=0 ROTATIONAL TRAJECTORY TESTS ARE DONE TO OBTAIN
C         MAXIMUMS AND MINIMUMS IN ALPRIM.
    7 IF(LOPT.NE.0)GO TO 30
      IF(IKMAX.EQ.200)GO TO 51
      IF(IKMIN.EQ.200)GO TO 51
      GO TO(8,9,10),IALP
    8 IALP=2
      SUMA2=0.D0
      SUMA3=0.D0
      ALSTO1=ALPRIM
      TSTO1=TIME
      ZSTO1=Z
      FSTO1=SMF
      GO TO 20
    9 IALP=3
      ALSTO2=ALPRIM
      TSTO2=TIME
      ZSTO2=Z
      FSTO2=SMF
      GO TO 20
   10 TEMMAX=ALSTO1
      IF(TEMMAX.LT.ALSTO2)TEMMAX=ALSTO2
      IF(TEMMAX.LT.ALPRIM)TEMMAX=ALPRIM
      TEMMIN=ALSTO1
      IF(TEMMIN.GT.ALSTO2)TEMMIN=ALSTO2
      IF(TEMMIN.GT.ALPRIM)TEMMIN=ALPRIM
      IF(IKMAX.EQ.0)GO TO 21
      TEMA=ALSTO1&ALSTO2
      TEMT=TSTO2-TSTO1
      SUMA2=SUMA2&0.5D0*TEMA*TEMT
      SUMA3=SUMA3&0.5D0*TEMA*TEMA*TEMT
   21 CONTINUE
      ALSTO1=ALSTO2
      ALSTO2=ALPRIM
      TSTO1=TSTO2
      TSTO2=TIME
      ZSTO1=ZSTO2
      ZSTO2=Z
      FSTO1=FSTO2
      FSTO2=SMF
      IF(TEMMAX.EQ.ALSTO1)GO TO 11
      IF(TEMMIN.EQ.ALSTO1)GO TO 12
      GO TO 20
   11 IKMAX=IKMAX&1
      IF(IKMAX.EQ.200)WRITE(6,2000)Z
 2000 FORMAT(1H0 20X,46H*****WARNING***** ALPHA MAX TABLE FILLED AT Z=,
     1F13.6,44H NO MORE MAXIMUMS OR MINIMUMS WILL BE STORED)
      IF(IKMAX-2)13,14,15
   13 ALMIC1=ALSTO1
      TMIC1=TSTO1
```

```
      ALMAX(IKMAX)=ALWIG1
      TAMAX(IKMAX)=TWIG1
      FMAX(IKMAX)=FSTO1
      ZMAX(IKMAX)=ZSTO1
      GO TO 20
   14 ALWIG2=ALSTO1
      TWIG2=TSTO1
      ALMAX(IKMAX)=ALWIG2
      TAMAX(IKMAX)=TWIG2
      FMAX(IKMAX)=FSTO1
      ZMAX(IKMAX)=ZSTO1
      GO TO 16
   15 ALWIG1=ALWIG2
      ALWIG2=ALSTO1
      TWIG1=TWIG2
      TWIG2=TSTO1
      ALMAX(IKMAX)=ALWIG2
      TAMAX(IKMAX)=TWIG2
      ZMAX(IKMAX)=ZSTO1
      FMAX(IKMAX)=FSTO1
      GO TO 16
   12 TBARP=TSTO1
      ALBARP=ALSTO1
      IKMIN=IKMIN&1
      IF(IKMIN.EQ.20)WRITE(6,2001)Z
 2001 FORMAT(1H0 20X,46H*****WARNING***** ALPHA MIN TABLE FILLED AT Z=,
     1E13.6,44H NO MORE MINIMUMS OR MAXIMUMS WILL BE STORED)
      ALMIN(IKMIN)=ALBARP
      TAMIN(IKMIN)=TBARP
      FMIN(IKMIN)=FSTO1
      ZMIN(IKMIN)=ZSTO1
      GO TO 20
   16 T=TWIG2-TWIG1
      SMF=1.D0/T
      ABAR2=0.D0
      ABAR3=0.D0
      DO 22 I=1,3
      II=I-1
      TEMI=THETAD**II
      ISUB11=120*II
      ISUB12=ISUB11&1
      DO 22 J=1,3
      JJ=J-1
      TEMJ=1.D0
      IF(JJ.NE.0)TEMJ=LAMSTO**JJ
      ISUB1=ISUB11&9*JJ
      ISUB2=ISUB12&9*JJ
      ABAR2=ABAR2&A(ISUB1)*TEMI*TEMJ
   22 ABAR3=ABAR3&A(ISUB2)*TEMI*TEMJ
      TEMP1=180.D0/PI
      DRATE=TEMP1*(ABAR2*SUMA2&TEMP1*ABAR3*SUMA3)
      SUMA2=0.D0
      SUMA3=0.D0
      IF(ALWIG2.GE.ALST)GO TO 20
      LOPT=1
      LP=1
      T=0.D0
      ALPHA=0.D0
      ALPR14=0.D0
      GO TO 20
```

```
 20   LAMSTO=LAMDA
      ALPENV=ALPRIM
      IF(T.EQ.0.D0)GO TO 30
      ALPENV=ALWIG1&(TWIG1-TIME)*(ALWIG2-ALWIG1)/(TWIG1-TWIG2)
 30   CONTINUE
C
C         FOR THE SIMPLIFIED ANGLE OF ATTACK CALCULATION, LOPT=2, ALPHA
C       ENVELOPE IS SET EQUAL TO INSTANTANEOUS VALUE OF ALPHA.
      IF(LOPT.NE.2)GO TO 91
      ALPENV=ALPRIM
 91   CONTINUE
      IF(LOPT.EQ.1)ALPENV=ALPRIM
C
C         BETA, VDOT/G, AND D(BETA)/DZ CALCULATION
      DOW=QD*AREF*CD/WTOTAL
      BETAST=BETA
      BETA=WTOTAL/(CD*AREF)
      IF(ICOM(10).EQ.1) BETA = WTOTAL/(CD*AREF-TH/QD)
      IF(ICOM(10).EQ.2)BETA=1.C/(WTOTAL/(CD*AREF-TH/QD))
      DENOM=Z-ZSTO
      IF(DENOM.EQ.0.DC)DENOM=1.0D-1C
      BETAP=(BETA-BETAST)/DENOM
      ZSTO=Z
      VGDOT=DERIV(1)/(G*DERIV(3))
C
C         TESTS FOR PRINTING IF LOPT IS LESS THAN OR EQUAL TO 2
      IF(Z.LE.(ZSTG1.DDC))GO TO 54
      IF(ABS(PRINTZ-Z).LT.DELPPI)GO TO 50
 54   PRINTZ=Z
      IF(PRINTZ.LE.(ZBAR&C.1DC))DELPPI=ZPR2
      FREQ=-DELPPI
C
C         SETTING PRINTOUT VALUES FOR LOPT=3 OR 4 OPTIONS
 101  CONTINUE
      IF(LOPT.LT.3)GO TO 1CC
      BETA=WTOTAL/(CD*AREF)
      VGDOT=0.CDO
      CVALUE(1)=V
      CVALUE(4)=C.CDO
      CVALUE(6)=RN
      CVALUE(13)=0.CDO
      PSIALP=C.CDO
      GO TO 80
C
C         STORAGE FOR THE TAPE OPTION
 100  CONTINUE
      NNTAPE=NNTAPE&1
C
C         STORAGE OF VALUES FOR PLOTTING
      IF(LPLOT.EQ.160)GO TO 80
      LPLOT=LPLOT&1
      IF(LPLOT.EQ.16C)WRITE(6,1080)Z,TIME
 1080 FORMAT(1H0,10X,47H*****WARNING***** PLOTS HAVE BEEN CUT OFF AT Z=,
     1E13.6,10H AND TIME=F7.2)
      ZPLOT(LPLOT)=Z
      TPLOT(LPLOT)=TIME
      PLMINF(LPLOT)=MINF
      CDPLOT(LPLOT)=CD
      CDPPLT(LPLOT)=CDB&CDP
      IF(Z.GT.ZTF)CDPPLT(LPLOT)=CDFINF(2,2,1)
```

```
      IF(Z.LT.ZTR)CDFPLT(LPLOT)=CDFINF(2,1,1)
      CDIPLT(LPLOT)=CDI
      WTOTPL(LPLOT)=WTOTAL/W1
      BETAPL(LPLOT)=BETA
      VPLOT(LPLOT)=DVALUE(1)
      VGPLT(LPLOT)=VGDOT
      QPLOT(LPLOT)=QD
      PSPLOT(LPLOT)=PS/2116.CDC
      HSLTPL(LPLOT)=HSRTC
      QD11PL(LPLOT)=QDOT(1,1)
      QD41PL(LPLOT)=QDOT(4,1)
      PE1PLT(LPLOT)=PEPSB(1)
      PE7PLT(LPLOT)=PEPSB(7)
      PE8PLT(LPLOT)=PEPSB(8)
      IF(Z.GE.ZTR)J=2
      IF(Z.LT.ZTR)J=3
      QD7PLT(LPLOT)=QDOT(J,7)
      QD8PLT(LPLOT)=QDOT(J,8)
      ALPLOT(LPLOT)=57.29578DC*ALPENV
      IF(NPLOT(5).LE.C)GO TO 8C
      IPLOT=NPLOT(5)
      UCPLOT(LPLOT)=DCCLR(IPLOT)
   8C CONTINUE
C
C
      IF(IOP(74).EQ.1) CALL WAKE
C
C
C          IF NPRINT = C, PRINTOUT IS OMITTED BUT TAPES AND PLOTS MAY
C        STILL BEING GENERATED.
      IF(NPRINT.EQ.C)GO TO 9C
C
C
C          BEGINNING OF PRINTOUT
C
C
C          PRINTOUT OF TRANSLATIONAL QUANTITIES
C          ALL ANGLES ARE CHANGED INTO UNITS OF DEGREES BEFORE BEING
C        PRINTED OUT.
      PSALLP=57.29578DC*DVALUE(15)
      GAMFP=57.29578DC*DVALUE(2)
      PSPC=PS/2116.CDC
      WRITE(6,1C32)TIME,Z          ,DVALUE(1),GAMFP,DVALUE(4),BETA,ZTR,
     1QD,MINF,VGDOT,BETAP,TH,TIMAT(1),DVALUE(14),PSALLP,DCW
 1032 FORMAT(1HC ///,54X,24HTRANSLATICNAL QUANTITIES//1CX,5HTIME=F7.2,
     15H   Z=E15.6,5H   V=E15.7,8H   GAMF=E12.4,6H   XR=E15.6,8H   BETA=
     2E12.4/25X,4HZTR=E13.6,6H   QD=F14.4,1H   MINF=E12.4,10H   VDOT,G=E
     311.4,9H   BETAP=F11.4/25X,3HTH=E14.4,7H   TXT=E13.4,6H   YR=E14.4,
     410H   PSIALP=E11.4,7H   D/W=F13.4)
      IF(IATMOS.EQ.C)GO TO 75
      IF(Z.GE.UPBNDZ)GO TO 75
      IF(Z.LT.DNBNDZ)GO TO 75
      WRITE(6,1075)UPBNDZ,DNBNDZ
 1075 FORMAT(1HC,2CX,*INPUT ATMOSPHERE BEING USED WHEN Z LESS THAN *,
     1E14.6,*, GREATER THAN OR EQUAL TO*,E14.6/)
   75 CONTINUE
C
C          UPAC COEFFICIENT PRINTOUT
      IF(Z.LT.ZTR)J=1
      IF(Z.GE.ZTR)J=2
```

```
      IF(J.EQ.1)JJ=3                                                    VIXFN600
      IF(J.EQ.2)JJ=2                                                    VIXFN601
      REYLA=(REYL*LA)/CAPL                                              VIXFN602
      WRITE(6,1034)CD,CDP,TITLE(J),CDFINF(2,J,1),CDB,CDPU,TITLE(J),     VIXFN603
     1CDFINF(2,J,2),CDI,XBAR,REYLA,XBAR1                                VIXFN604
 1034 FORMAT(1H0 58X,15HDRAG QUANTITIES//25X,3HCD=E14.4,7H    CDP=E13.4, VIXFN605
     113H   CDFINF(BL,A4,5H,WB)=E12.4,10X,4HCDB=E13.4/45X,5HCDPU=E12.4, VIXFN606
     213H   CDFINF(BL,A4,5H,NB)=E12.4,10X,4HCDI=E13.4/45X,5HXBAR=E12.4, VIXFN607
     312H   REYINFLA=,10X,E12.4,10X,6HXBAR1=E11.4)                      VIXFN608
      IF(J.EQ.1)GO TO 1040                                              VIXFN609
      WRITE(6,1039) DELCDP,DECDFP,DECFTC                                VIXFN610
 1039 FORMAT(54X,22HLAMINAR CDI COMPONENTS/45X,6HCDI/P=F11.4,10H    CDI/SVIXFN611
     1F=,12X,E12.4,10X,7HCDI/TC=E11.4)                                  VIXFN612
 1040 CONTINUE                                                          VIXFN613
C                                                                       VIXFN614
C            PRINTOUT OF CONFIGURATION PARAMETERS                       VIXFN615
      LA=LA*12.0D0                                                      VIXFN616
      DVALUE(6)=DVALUE(6)*12.0D0                                        VIXFN617
      WRITE(6,1036)DVALUE(6),THETAD,LA,LAMDA,AREF,WTOTAL,DELW,DELW2,    VIXFN618
     1DELW3                                                             VIXFN619
 1036 FORMAT(1H0 55X,13HCONFIGURATION//25X,3HRN=E14.4,9H   THETA=E11.4, VIXFN620
     116H   LA=E14.4,10H   LAMBDA=E11.4,8H   AREF=E12.4/25X,2HW=E15.4,  VIXFN621
     229H   DELW=E12.4,8H   WABL=E12.4,10H   WTHRST=E11.4)              VIXFN622
      LA=LA/12.0D0                                                      VIXFN623
      DVALUE(6)=DVALUE(6)/12.0D0                                        VIXFN624
C                                                                       VIXFN625
C            IF THE MASS LOSS OPTIONS ARE NOT BEING USED, THE PRINTOUT IS VIXFN626
C        BYPASSED.                                                      VIXFN627
      IF(MOPT.EQ.0)GO TO 88                                             VIXFN628
C                                                                       VIXFN629
C            HEATING AND MASS LOSS PRINTOUT                             VIXFN630
      IF(TIMER.EQ.TO)TLAST=0.0D0                                        VIXFN631
      DO 24 I=1,8                                                       VIXFN632
      IF(TLAST.EQ.0.0D0)GO TO 24                                        VIXFN633
      QINT(I)=QINT(I)&0.5D0*(QDOT(JJ,I)&QLAST(I))*(TIMER-TLAST)         VIXFN634
   24 QLAST(I)=QDOT(JJ,I)                                               VIXFN635
      IF(TLAST.EQ.0.0D0)GO TO 26                                        VIXFN636
      QINST=QINST&0.5D0*(QDOT(1,1)&QSTLST)*(TIMER-TLAST)                VIXFN637
      QINSON=QINSON&0.5D0*(QDOT(4,1)&QLTSON)*(TIMER-TLAST)              VIXFN638
      GO TO 28                                                          VIXFN639
   26 DO 27 I=1,8                                                       VIXFN640
   27 QINT(I)=0.0D0                                                     VIXFN641
      QINST=0.0D0                                                       VIXFN642
      QINSON=0.0D0                                                      VIXFN643
   28 QSTLST=QDOT(1,1)                                                  VIXFN644
      QLTSON=QDOT(4,1)                                                  VIXFN645
      TLAST=TIMER                                                       VIXFN646
      WRITE(6,1035)QDOT(1,1),QDOT(4,1),HSRTO,PSPJ,(PEPSB(LJ),LJ=1,8),   VIXFN647
     1(QDOT(JJ,LJ),LJ=1,8),(MDOT(JJ,LJ),LJ=1,8),(QINT(LJ),LJ=1,8),QINST,VIXFN648
     2QINSON                                                            VIXFN649
 1035 FORMAT(1H0 61X,9HMASS LOSS//22X,11HQDOT(STAG)=E11.4,7X,12HQDOT(SONVIXFN650
     1IC)=E11.4,7X,6HHSRTO=E11.4,7X,5HPSPO=E12.4/12X,46HX STATIONS ARE PVIXFN651
     2ERCENTAGES OF UNABLATED LENGTH//22X,9HTANG. PT.,5X,8HX/LA=0.2,5X, VIXFN652
     38HX/LA=0.4,5X,8HX/LA=0.6,5X,9HX/LA=0.75,4X,8HX/LA=0.9,5X,8HX/LA=1.VIXFN653
     40,5X,9HCONE R=RB/12X,7HPEPSB= 8E13.4/12X,7HQDOT=   8E13.4/12X,7HMDOVIXFN654
     5T=  ,8E13.4/12X,7HQ INT= ,8E13.4/22X,13HQ INT(STAG)= E11.4,24X,15HVIXFN655
     6Q INT(SONIC)= E11.4,16H  TURBULENT ONLY )                         VIXFN656
C                                                                       VIXFN657
   88 CONTINUE                                                          VIXFN658
      IF(ALPHA.GT.0)GO TO 52                                            VIXFN659
```

```
      IF(LOPT.EQ.1)GO TO 52
C
C          ROTATIONAL QUANTITIES PRINTOUT  FOR LOPT = 0 OR 2
       PSIP=57.295780D0*DVALUE(8)
       THLP=57.295780D0*DVALUE(9)
       PHIP=57.295780D0*DVALUE(10)
      ALPRIP=57.295780D0*ALPRIM
      ALENVP=57.295780D0*ALPENV
      IF(SMF.EQ.0.0D0)TBAR=0.0D0
      IF(SMF.NE.0.0D0)TBAR=1.0D0/SMF
      AAA=PHIP/360.D0
      NNN=AAA
      BBB=NNN
      PHIP=PHIP-360.D0*BBB
      IF(PHIP.LT.0.D0)PHIP=360.D0&PHIP
      WRITE(6,1033)PSIP,THLP,PHIP,ALPRIP,DVALUE(13),DVALUE(11),DVALUE(12
     1),ALENVP,CMO,CM,CN,SMF,TBAR
 1033 FORMAT(1H0 55X,21HROTATIONAL QUANTITIES//25X,4HPSI=E13.4,10H    THE
     1ALP=E11.4,6H  PHI=E13.4,10H   ALPRIM=E11.4/25X,3HPR=E14.4,5H   Q=,
     2E14.4,8H    SMR=E13.4,10H   ALPENV=E11.4/25X,4HCMC=E13.4,6H   CM=
     3E13.4,7H    CN=E14.4,7H   SMF=E14.4,8H   TBAR=E12.4  )
      GO TO 90
C
C          INPUT ANGLE OF ATTACK PRINTOUT
   52 CONTINUE
      ALPHID = ALPHA * 57.295780D0
      WRITE(6,1042) ALPHID
 1042 FORMAT(1H0 41X,37HTABULAR INPUT ANGLE OF ATTACK ALPHA =,E12.4)
      IF(LOPT.LE.2)GO TO 90
C
C          SEQUENCING FOR LOPT=3 OR 4 WHICH CAUSES REPEAT OF CALCULATION
C        FOR NEXT SET OF VALUES IN TABLES, UNLESS FINAL SET OF VALUES
C        HAS ALREADY BEEN USED - THEN CAUSES RETURN TO MAIN PROGRAM.
C         PLOTTING ROUTINES ARE BYPASSED WHEN LOPT = 3 OR 4.
   49 CONTINUE
      IF(MAXVAL.EQ.0)WRITE(6,1025)
      IF(MAXVAL.EQ.0)MAXVAL=1
 1025 FORMAT(1H0,10X,'*****WARNING***** YOU FORGOT TO INPUT MAXVAL FOR L
     1OPT=3 OR 4 CASE')
      IF(NK.EQ.(MAXVAL-1))GO TO 834
      NK=NK&1
      GO TO 3
C
C
C          STOPPING TESTS FOR LOPT LESS THAN OR EQUAL TO 2.
   90 CONTINUE
      IF(TIME.GT.TST)GO TO 51
      IF(Z.LE.(ZST&1.0D0))GO TO 51
      IF(LP.GE.3)GO TO 51
      GO TO 50
   51 IF(NPRINT.NE.0)CALL RITOUT
C
      DO 81 J=1,5
      IF(NPLOT(J).GT.0)GO TO 82
   81 CONTINUE
      GO TO 833
C
C          PLOTTING OPTIONS
 82   CONTINUE
      IF(NPLOT(1).LE.0)GO TO 84
```

```
      CALL AVPLT(TIXZ,T1,ZPLOT,CDPLCT,ZPLCT,3,1)                        VIXFN720
      CALL AVPLT(TIXM,T2,PLMINF,CDPPLT,ZPLOT,3,1)                       VIXFN721
      CALL AVPLT(TIXZ,T3, ZPLOT,CDFPLT,ZPLCT,3,1)                       VIXFN722
      CALL AVPLT(TIXZ,T4, ZPLOT,CDIPLT,ZPLOT,3,1)                       VIXFN723
   84 CONTINUE                                                          VIXFN724
      IF(NPLOT(2).LE.0)GO TO 85                                         VIXFN725
      CALL AVPLT(TIXZ,T6, ZPLOT,BETAPL,ZPLOT,3,1)                       VIXFN726
      CALL AVPLT(TIXT,T7, TPLOT, VPLOT,ZPLOT,3,1)                       VIXFN727
      CALL AVPLT(TIXT,T8, TPLOT,PLMINF,ZPLOT,3,1)                       VIXFN728
      CALL AVPLT (TIXT,T9,TPLOT,VCCPLT,ZPLOT,3,1)                       VIXFN729
      CALL AVPLT(TIXT,T10,TPLOT, ZPLOT,ZPLCT,3,1)                       VIXFN730
      CALL AVPLT(TIXT,T11,TPLOT, QPLOT,ZPLCT,3,1)                       VIXFN731
   85 CONTINUE                                                          VIXFN732
      IF(NPLOT(3).LE.0)GO TO 86                                         VIXFN733
      CALL AVPLT(TIXZ,T5, ZPLOT,WTOTPL,ZPLOT,3,1)                       VIXFN734
      CALL AVPLT(TIXT,T12,TPLOT,PSPLOT,ZPLOT,3,1)                       VIXFN735
      CALL AVPLT(TIXT,T13,TPLOT,HSRTPL,ZPLOT,3,1)                       VIXFN736
      IF(LAMDA.NE.0.0D0)GO TO 851                                       VIXFN737
      CALL AVPLT(TIXT,T14,TPLOT,QD11PL,ZPLOT,3,1)                       VIXFN738
      CALL AVPLT(TIXT,T17,TPLOT,QD8PLT,ZPLOT,3,1)                       VIXFN739
      CALL AVPLT(TIXT,T18,TPLOT,PE1PLT,ZPLOT,3,1)                       VIXFN740
      CALL AVPLT(TIXT,T20,TPLOT,PE8PLT,ZPLOT,3,1)                       VIXFN741
      GO TO 86                                                          VIXFN742
  851 CALL AVPLT(TIXT,T14,TPLOT,QD11PL,ZPLOT,3,1)                       VIXFN743
      CALL AVPLT(TIXT,T15,TPLOT,QD41PL,ZPLOT,3,1)                       VIXFN744
      CALL AVPLT(TIXT,T16,TPLOT,QD7PLT,ZPLOT,3,1)                       VIXFN745
      CALL AVPLT(TIXT,T17,TPLOT,QD8PLT,ZPLOT,3,1)                       VIXFN746
      CALL AVPLT(TIXT,T18,TPLOT,PE1PLT,ZPLOT,3,1)                       VIXFN747
      CALL AVPLT(TIXT,T19,TPLOT,PE7PLT,ZPLOT,3,1)                       VIXFN748
      CALL AVPLT(TIXT,T20,TPLOT,PE8PLT,ZPLOT,3,1)                       VIXFN749
   86 CONTINUE                                                          VIXFN750
      IF(NPLOT(4).LE.0)GO TO 87                                         VIXFN751
      CALL AVPLT(TIXT,T21,TPLOT,ALPLOT,ZPLOT,3,1)                       VIXFN752
   87 CONTINUE                                                          VIXFN753
      IF(NPLOT(5).LE.0)GO TO 833                                        VIXFN754
      CALL AVPLT(TIXT,T22,TPLOT,DCPLOT,ZPLOT,3,1)                       VIXFN755
  833 CONTINUE                                                          VIXFN756
      IF(IOP(74).EQ.0) GO TO 837                                        VIXFN757
      IF(IOP(77).EQ.1) CALL AVPLT(TIXZ,T23,ZPLOT,WL1P,ZPLCT,ICBL,1)     VIXFN758
      IF(IOP(78).EQ.1) CALL AVPLT(TIXZ,T24,ZPLOT,WL2P,ZPLCT,ICBL,1)     VIXFN759
      IF(IOP(79).EQ.1) CALL AVPLT(TIXZ,T25,ZPLOT,WL3P,ZPLCT,ICBL,1)     VIXFN760
      IF(IOP(80).EQ.1) CALL AVPLT(TIXZ,T26,ZPLOT,WR1P,ZPLCT,ICBL,0)     VIXFN761
      IF(IOP(81).EQ.1) CALL AVPLT(TIXZ,T27,ZPLOT,WR2P,ZPLCT,ICBL,0)     VIXFN762
      IF(IOP(82).EQ.1) CALL AVPLT(TIXZ,T28,ZPLOT,WR3P,ZPLCT,ICBL,0)     VIXFN763
  837 CONTINUE                                                          VIXFN764
C                                                                       VIXFN765
C          OPTION FOR TAPE OF V, BETA, Z                                VIXFN766
      IF(ITAPE.EQ.0)GO TO 834                                           VIXFN767
      VVAR=0.0D0                                                        VIXFN768
      WRITE(8)DATE,EMO,CASE,NNTAPE                                      VIXFN769
      WRITE(8)(VVAR,ZPLOT(I),VPLOT(I),VVAR,BETAPL(I),VVAR,VVAR,VVAR,    VIXFN770
     1VVAR,I=1,NNTAPE)                                                  VIXFN771
C                                                                       VIXFN772
C          CHANGING ANGLES BACK TO UNITS OF DEGREES TO PREPARE FOR NEW  VIXFN773
C        INPUT QUANTITIES.                                              VIXFN774
  834 CONTINUE                                                          VIXFN775
      THETA=THETA/0.01745329D0                                          VIXFN776
      GAMFC=GAMFC/0.01745329D0                                          VIXFN777
      PHIC=PHIC/0.01745329D0                                            VIXFN778
      PSIC=PSIC/0.01745329D0                                            VIXFN779
```

```
436 CONTINUE                                                  VIXFN775
      THETA=THETA/0.0174532SD0                                VIXFN776
      GAMFC=GAMFC/0.0174532SD0                                VIXFN777
      PHIO=PHIO/0.0174532SD0                                  VIXFN778
      PSIO=PSIO/0.0174532SD0                                  VIXFN779

      THEALO=THEALO/0.0174532SD0                              VIXFN780
      RETURN                                                  VIXFN781
      END                                                     VIXFN782
```

```
CWAKE
      SUBROUTINE WAKE
      IMPLICIT REAL*8(A-H,O-Z)
      REAL *8  MUINF, MINF, ME
      COMMON /CPCCUR/ PCCUR(11770)
      COMMON /CIOCUR/ IOCCUR(320)
      COMMON OCCUR,NOCCUR
      COMMON /NINPUT/ AKW,RHOW,CPHOW,DELWH,       TABL,CHCHEM,RHCSL,
     1   RTO,PCON,ACON,     B21,B22,B23,      C(169)
      COMMON /CWAKE/ BETAZ,FRO1,FRO2,FRO3,PHI1,PHI2,PHI3,SIGNL1,SIGNL2,
     1SIGNL3,TAU1,TAU2,TAU3,WKALT,WSTALT,INO,IWAKE,IWPRNT
      COMMON /CRCSEC/ T,TAU,SIGMDS,PHI,XBZ,ZME,HH,DDW,C1,C2,C3,C4,C5
      COMMON /ERLTNK/ BZ,RN,THETAC,DP,GAMMAE,CDTA,CDVA,PICIPU,PL,
     1   AMU,RHOU,UU,HU,AMUU,AMINFC,RHOIC,HINFC,UINFC,AMULSO,
     2   AMABLD,Z,SC,ZBLT
      DIMENSION OCCUR(1000)
      DIMENSION NOCCUR(10)
      DIMENSION WL1P(160), WL2P(160), WL3P(160), WR1P(160), WR2P(160)
       DIMENSION WR3P(160), ZPLOT(160), A(514), IOP(90)
      DIMENSION BETAZ(10),PHI1(10), PHI2(10), PHI3(10), WKALT(10)
      EQUIVALENCE(OCCUR(001),AREF)
      EQUIVALENCE(OCCUR(014),CF)
      EQUIVALENCE(OCCUR(017),CPE)
      EQUIVALENCE(OCCUR(021),D)
      EQUIVALENCE(OCCUR(026),GAME)
      EQUIVALENCE(OCCUR(034),MUINF)
      EQUIVALENCE(OCCUR(035),MINF)
      EQUIVALENCE(OCCUR(036),ME)
      EQUIVALENCE(OCCUR(048),PE)
      EQUIVALENCE(OCCUR(049),PINF)
       EQUIVALENCE (OCCUR(052),RNMX  )
       EQUIVALENCE (OCCUR(056),RHOINIT)
       EQUIVALENCE (OCCUR(061),RHOE  )
       EQUIVALENCE (OCCUR(072),TINF  )
       EQUIVALENCE (OCCUR(074),THETA )
       EQUIVALENCE (OCCUR(076),TE    )
       EQUIVALENCE (OCCUR(082), V    )
       EQUIVALENCE (OCCUR(083), VE   )
       EQUIVALENCE (OCCUR(086), WDOT  )
       EQUIVALENCE (OCCUR(090), XBAR  )
       EQUIVALENCE (OCCUR(091), ZNK   )
       EQUIVALENCE (OCCUR(092), ZTR   )
       EQUIVALENCE (OCCUR(098), CDP   )
       EQUIVALENCE (OCCUR(099), CDB   )
       EQUIVALENCE (OCCUR(100), CPI   )
       EQUIVALENCE (OCCUR(239), XLCW  )
       EQUIVALENCE (OCCUR(301), A     )
      EQUIVALENCE (IOCCUR(00001), IOP)
      EQUIVALENCE (IOCCUR(00316), IDPL  )
      EQUIVALENCE (IOCCUR(00302), IPLCT )
      EQUIVALENCE (PCCUR(01281), WL1P  )
      EQUIVALENCE (PCCUR(01441), WL2P  )
      EQUIVALENCE (PCCUR(01601), WL3P  )
      EQUIVALENCE (PCCUR(00801), WR1P  )
      EQUIVALENCE (PCCUR(00961), WR2P  )
      EQUIVALENCE (PCCUR(01121), WR3P  )
      EQUIVALENCE (PCCUR(00161), ZPLCT )
      EQUIVALENCE (NOCCUR(03), NOPT  )
       NAMELIST/NAM1/ BZ,RN,THETAC,DP,GAMMAE,CDTA,CDVA,PICIPU,PL,
```

```
     1   AMU,RHOU,UU,HU,AMOU,AMINFC,RHOIC,HINFC,UINFC,AMBLSD,
     2   AMABLD,Z,SC,ZBLT
C
C
C          SUBROUTINE WAKE CALCULATES SOME QUANTITIES NEEDED BY SUB-
C        ROUTINES PLOWF AND RCSEC, THEN CALLS THESE SUBROUTINES TO
C        CALCULATE THE VEHICLE WAKE LENGTH AND CROSS SECTION AT EACH OF
C        THREE RADAR FREQUENCIES
C
C
      IF(IWOPNT.EQ.0) GO TO 10
      WRITE(6,1000)(A(I),I=105,112),AREF,ZTB,ZNX,D,RNNX,THETA,GAME,CD,
     1 CDP,CDB,CDI,PE,PINF,MINF,RHOINL,V,TINF,MUINF,ME,RHOE,CPE,TE,
     3 VE,WDOT,XBAR,XLOW
C
10    IF(ZNX.LE.WSTALT.AND.XBAR.LT.XLOW) GO TO 30
      WL1P(LPLOT) = 0.D0
      WL2P(LPLOT) = 0.D0
      WL3P(LPLOT) = 0.D0
      WR1P(LPLOT) = 1.D0
      WR2P(LPLOT) = 1.D0
      WR3P(LPLOT) = 1.D0
      RETURN
C
30    CALL INTERP(10,IWAKE,ZPLOT(LPLOT),WKALT,BETAZ,BZ)
      FUG1 = 1.D3
      FUG2 = 778.D0*32.174D0
C
C          THE FOLLOWING CALCULATIONS ARE FOR RCSEC
      XBZ = BZ
      ZNE = MINF
       HH = ZNX / FUG1
      RDV = D/3.281D0
       C1 = C(1)
       C2 = C(2)
       C3 = C(3)
       C4 = C(4)
       C5 = C(5)
C
C          THE FOLLOWING CALCULATIONS ARE FOR PLOWF.
      RN = RNNX
      THETAC = THETA
      DB = D
      GAMMAE = DABS(GAME)
      CDTA = CD*AREF
       CDVA = (CD-(CDP & CDB & CDI )) * AREF
      PICIPI = PE/PINF
      PU = PINF
      AMU = MINF
      RHOU = RHOINL
       UU = V / FUG1
      IF(TINF.GT.5.D3) GO TO 66
      IF(TINF.LT.7.D2) GO TO 70
      CPINF = 0.D0
      DO 71 I = 1,6
71    CPINF = CPINF & A(I&104)* TINF**(I-1)
      GO TO 72
66    CPINF = A(111) & A(112)*TINF
      GO TO 72
70    CPINF = .235D00
```

```
72    HU = CPINF*TINF*FUG2
      AMUU = MUINF
      AMINFC = MF
      RHOIC = RHOF
      HINFC = CPF*TF*FUG2
      UINFC = VF/FUG1
      IF(RN.GE..495D0*DB) GO TO 78
      FUG3 = RICIPU*AMINFC/AMU
      FUG4 = DB**3*RHOU *UU*AMUU/(RHOSL*DSIN(THETAC))
       AMBLSD = 1005.D0 * (HINFC / HU)**.25D0 * DSQRT(FUG3 * FUG4)
      GO TO 79
78    FUG5 = 1.D2*RHOL*UU*DB/ AMUU
       AMBLSD = C(76) * RHOU * UU * AREF* FUG5**C(77)
79     AMABLD = -WDOT
      IF(MOPT.EQ.0) AMABLD = 0.D00
       Z = ZNX / FUG1
      IF(.495D0*DB.GT.RN) GO TO 101
      SC = 0.D0
      GO TO 102
101    SC = (.5D0 * DB - RN * DCOS(THETAC)) / DSIN(THETAC)
102   ZPLT = ZTR/FUG1
C
C
C
      CALL FLOWF(ENET,B1,IND)
      IF(IWPRNT.EQ.1) WRITE(6,2000) ENET, B1
      IF(IWPRNT.EQ.1) WRITE(6,NAM1)
C
      IF((IOP(67) + IOP(70)).EQ.0) GO TO 40
      CALL INTERP(10,IWAKE,ZPLOT(LPLOT),WKALT,PHI1,PHI)
      F = FR01
      TAU = TAU1
      SIGMOS = SIGML1
      CALL RCSEC(B1,ENET,WL1P(LPLOT),WR1P(LPLOT),IOP(67))
      IF(WR1P(LPLOT).GT.0.D0) GO TO 35
      WR1P(LPLOT) = 0.D0
      IF(IOBL.EQ.4) WR1P(LPLOT) = 1.D0
      GO TO 40
C
35    IF(IOBL.EQ.3) WR1P(LPLOT) = 10.D0*DLOG10(WR1P(LPLOT))
C
C
40    IF((IOP(68) + IOP(71)).EQ.0) GO TO 50
      CALL INTERP(10,IWAKE,ZPLOT(LPLOT),WKALT,PHI2,PHI)
      F = FR02
      TAU = TAU2
      SIGMOS = SIGML2
      CALL RCSEC(B1,ENET,WL2P(LPLOT),WR2P(LPLOT),IOP(68))
      IF(WR2P(LPLOT).GT.0.D0) GO TO 45
      WR2P(LPLOT) = 0.D0
      IF(IOBL.EQ.4) WR2P(LPLOT) = 1.D0
      GO TO 50
C
45     IF(IOBL.EQ.3) WR2P(LPLOT) = 10.D0*DLOG10(WR2P(LPLOT))
C
C
50    IF((IOP(69) + IOP(72)).EQ.0) GO TO 60
      CALL INTERP(10,IWAKE,ZPLOT(LPLOT),WKALT,PHI3,PHI)
      F = FR03
      TAU = TAU3
```

```
      SIGMDS = SIGNL3                                                   WAKE 180
      CALL RCSPC(R1,FNET,WL3P(LPLOT),WR3P(LPLOT),IOP(69))               WAKE 181
      IF(WR3P(LPLOT).GT.0.D0) GO TO 55                                  WAKE 182
      WR3P(LPLOT) = 0.D0                                                WAKE 183
      IF(IPBL.EQ.4) WR3P(LPLOT) = 1.D0                                  WAKE 184
      GO TO 60                                                          WAKE 185
C                                                                       WAKE 186
55    IF(IPBL.EQ.3) WR3P(LPLOT)=10.D0*DLOG10(WR3P(LPLOT))               WAKE 187
C                                                                       WAKE 188
C                                                                       WAKE 189
60    RETURN                                                            WAKE 190
C                                                                       WAKE 191
2000  FORMAT(1H0 11HWAKE FNET = 1PE15.7, 1X 4HR1 = E15.7)               WAKE 192
1000  FORMAT(1H03X6HA(105)8X6HA(106)8X6HA(107)8X6HA(108)8X6HA(109)8X6HA(WAKE 193
     1110) 8X6HA(111)8X6HA(112)10X4HGRDF/1H 1P8E14.7/1H 11X3HZTP11X3HZNXWAKE 194
     2 13X1HD10X4HRNNX9X5HTHETA10X4HGAMF12X2HCD11X3HCDP11X3HCCP/1H     WAKE 195
     3 1P8E14.7/1H 11X3HCDI12X2HPF10X4HPINF10X4HMINF9X6HPHCIN113X1HV10X WAKE 196
     1 4HTINF9X5HMUINF12X2HME/1H 1P8E14.7/1H 10X4HRHOE11X3HCPE12X2HTE   WAKE 197
     2 12X2HVE10X4HWDCT10X4HXBAR10X4HXLOW/1H 1P7E14.7)                  WAKE 198
      END                                                               WAKE 199
```

```
CWRITEM
CWRITEM PROGRAM 25620
      IMPLICIT REAL*8(A-H,O-Z)
      SUBROUTINE WRITEM(IX,Z,T,Q,R,S,DA,DB,SLOPE,N)
C
C
C          EACH TIME SUBROUTINE WRITEM IS CALLED, A SINGLE LINE MAY BE
C          PRINTED IN THE CORRIDOR INTEGRAL TABLE.
C
C
      IF(N.EQ.0) RETURN
       IX = IX/10
      GO TO (10, 20, 30, 40, 50, 60), IX
10    WRITE(6,1000)Z,T,Q,R,S,DA
      RETURN
20    WRITE(6,1100)Z,T,Q,R,S,DA,DB
      RETURN
30    WRITE(6,1400)Z,T,Q,R,S,DA,DB
      RETURN
40    WRITE(6,1300)Z,T,Q,R,S,DA,SLOPE
      RETURN
50    WRITE(6,1500)Z,T,Q,R,S,DA,DB,SLOPE
      RETURN
60    WRITE(6,1400)Z,T,Q,R,S,DA,DB,SLOPE
      RETURN
1000  FORMAT(1H F14.1,4F14.2,1PE14.7,2F14.1,1PE14.7)
1100  FORMAT(1H F14.1,4F14.2,1PE14.7,14X0PF14.1)
1300  FORMAT(1H F14.1,4F14.2,1PE14.7,28X1PE14.7)
1400  FORMAT(1H F14.1,4F14.2,1PE14.7,0PF14.1,14X1PE14.7)
1500  FORMAT(1H F14.1,4F14.2,1PE14.7,14X,0PF14.1,1PE14.7)
      END
```

```
CZPRM
      IMPLICIT REAL*8 (A-H,O-Z)
      SUBROUTINE ZPRM
      COMMON /IGPHL/ IGPL(20), IGPH(20)
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      COMMON /SENSE/ ISEN1, ISEN2
      COMMON /MIN/ALOW(20),UP(20),AMULT(20),CALOW(20),CTP(20)
      COMMON /IOPT/IPROC,IN,NCONS,IPNT,IFX,LIMIT,IRAND
      COMMON /FOPT/ERR,PRAND,FAC,DELTA
      COMMON/OWL/OVECT(20),WRF,LRED
      COMMON /NALTEG/FGSM,NALT
      COMMON/DOPT/DELX(20)
      COMMON /MULT/ SMULT(25)
      EQUIVALENCE (XCOM(1),ALPHA)
      EQUIVALENCE (XCOM(2),BETA)
      EQUIVALENCE (XCOM(3),GAMMA)
      EQUIVALENCE (XCOM(4),DEL)
      EQUIVALENCE (XCOM(5),RATL)
      EQUIVALENCE (XCOM(6),TOL)
C
C
C          SUBROUTINE ZPRM PRESETS THE VALUES OF SOME OF THE VARIABLES
C        USED IN THE PROGRAM.
C
C
      DO 10 I = 1,200
      ICOM(I) = 0
   10 CONTINUE
C
      DO 11 I = 1, 20
       IGPH(I) = 0
       IGPL(I) = 0
      ALOW(I) = 0.D0
      AMULT(I) = 1.D0
      CALOW(I) = 0.D0
      CTP(I) = 0.D0
      DELX(I) = .001DC
      OVECT(I) = 5.D0
      UP(I) = 0.D0
   11 CONTINUE
C
      DO 22 I = 1, 25
      SMULT(I) = 1.D0
   22 CONTINUE
C
      ERR = 0.01D0
      FGSM = 4.D0
      IFX = 2
      IN = 1
      IPROC = 1
      IRAND = 0
      ISEN1 = 0
      ISEN2 = 0
      LIMIT = 30
      NALT = 0
      NCONS = 1
      PRAND = 0.D0
      WRF = .9D0
      XCOM(1) = 3.D0
```

```
      XCON(2) = .500                                                    ZPRM  60
      XCON(3) = .500                                                    ZPRM  61
      XCON(4) = .0100                                                   ZPRM  62
      XCON(5) = .500                                                    ZPRM  63
      XCON(6) = 1.D-4                                                   ZPRM  64
C                                                                       ZPRM  65
      RETURN                                                            ZPRM  66
      END                                                               ZPRM  67
```

```
CZPRS
      SUBROUTINE ZPRS(A,B)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION A(516), B(21)
C
C
C         SUBROUTINE ZPRS DEFINES THE ELEMENTS OF THE A AND B ARRAYS
C        WHICH ARE COEFFICIENTS OF THE CURVE FITS CONTAINED IN VARIOUS
C        OTHER SUBROUTINES.
C
C
C
C         COEFFICIENTS FOR THE PROBABILITY DISTRIBUTION BETWEEN FREE
C        MOLECULE AND CONTINUUM FLOW REGIMES, USED IN SUBROUTINE DRAGCO.
      B(01)=0.930930D0
      B(02)=0.118470D0
      B(03)=-0.222490D-1
      B(04)=-0.256360D-2
      B(05)=-0.303250D-2
      B(06)=-0.221750D-2
      B(07)=0.621930D-2
      B(08)=0.203850D-3
      B(09)=-0.134120D-2
      B(10)=-0.793290D-4
      B(11)=0.221050D-3
      B(12)=-0.106390D-5
      B(13)=-0.213930D-4
      B(14)=0.936020D-6
      B(15)=0.123410D-5
      B(16)=-0.781630D-7
      B(17)=-0.404310D-7
      B(18)=0.277600D-8
      B(19)=0.643060D-9
      B(20)=-0.434740D-10
      B(21)=-0.295370D-11
C
C         COEFFICIENTS USED IN FINDING MAXIMUMS AND MINIMUMS OF ALPHA
C        IN SUBROUTINE VIXEN.
        A(11)=4.546917D-01
        A(12)=1.092890D-01
        A(13)=7.526663D-02
        A(14)=9.927520D-02
        A(15)=-1.832002D-02
        A(16)=-9.132877D-03
        A(17)=-4.323047D-03
        A(18)=9.099082D-04
        A(19)=2.959707D-04
        A(20)=1.693470D+01
        A(21)=-6.500104D+00
        A(22)=-1.070516D-01
        A(23)=-2.577608D+00
        A(24)=9.214632D-01
        A(25)=5.861901D-02
        A(26)=1.296622D-01
        A(27)=-3.555784D-02
        A(28)=7.004716D-03
        A(29)=-5.351690D+01
        A(30)=1.517580D+01
        A(31)=-4.108702D-01
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      A(32)=9.7471559D00                                                ZPRS  60
      A(33)=-2.7730470D0                                                ZPRS  61
      A(34)=9.1575960D-02                                               ZPRS  62
      A(35)=-4.2004070D-01                                              ZPRS  63
      A(36)=1.0571590D-01                                               ZPRS  64
      A(37)=-3.7212170D-3                                               ZPRS  65
C                                                                       ZPRS  66
C        COEFFICIENTS USED IN CALCULATING BLUNT CONE PRESSURE DISTRI-   ZPRS  67
C      BUTIONS FOR CONE HALF ANGLES GREATER THAN OR EQUAL TO            ZPRS  68
C      20 DEGREES IN AERODY.                                            ZPRS  69
      A(41)=1.4915752701                                                ZPRS  70
      A(42)=-9.6849505500-1                                             ZPRS  71
      A(43)=1.7952455801                                                ZPRS  72
      A(44)=-3.4469658000                                               ZPRS  73
      A(45)=-5.0879922300                                               ZPRS  74
      A(46)=8.0920233D-1                                                ZPRS  75
      A(47)=-1.8517916801                                               ZPRS  76
      A(48)=1.2310255500                                                ZPRS  77
      A(49)=-1.0615937601                                               ZPRS  78
      A(50)=3.9213215300                                                ZPRS  79
      A(51)=5.7309228800                                                ZPRS  80
      A(52)=-9.0089157200-01                                            ZPRS  81
      A(53)=6.0446217100                                                ZPRS  82
      A(54)=-4.4066580 1D-1                                             ZPRS  83
      A(55)=5.3632613600                                                ZPRS  84
      A(56)=-1.0490477500                                               ZPRS  85
      A(57)=-1.5986864400                                               ZPRS  86
      A(58)=2.4979807 5D-1                                              ZPRS  87
C                                                                       ZPRS  88
C        COEFFICIENTS USED IN CALCULATING EDGE TEMPERATURE IN PRELIM.   ZPRS  89
      A(90)=2.3958375D0                                                 ZPRS  90
      A(91)=1.6270175D0                                                 ZPRS  91
      A(92)=-2.3542520-01                                               ZPRS  92
      A(93)=2.4184420-02                                                ZPRS  93
      A(94)=-7.1630150-04                                               ZPRS  94
      A(95)=-6.1255330D02                                               ZPRS  95
      A(96)=9.0910905D01                                                ZPRS  96
      A(97)=-1.6729420D0                                                ZPRS  97
      A(98)= 2.5912010-01                                               ZPRS  98
      A(99)=61.2416150-02                                               ZPRS  99
      A(100)=2.1759520D03                                               ZPRS 100
      A(101)= 2.4479300D02                                              ZPRS 101
      A(102)=-5.4835570D01                                              ZPRS 102
      A(103)=6.1643420D0                                                ZPRS 103
      A(104)=-1.9469720-01                                              ZPRS 104
C                                                                       ZPRS 105
C        COEFFICIENTS USED IN CALCULATING SPECIFIC HEATS AT CONSTANT    ZPRS 106
C      PRESSURE WHEN TEMPERATURE IS IN THE RANGE 700 TO 5000 DEGREES    ZPRS 107
C      RANKINE INCLUSIVE.  USED IN SUBROUTINE PRELIM.                   ZPRS 108
      A(105)=0.213100                                                   ZPRS 109
      A(106)=0.4573900-06                                               ZPRS 110
      A(107)= 0.772280-08                                               ZPRS 111
      A(108)=0.478690-12                                                ZPRS 112
      A(109)=0.000                                                      ZPRS 113
      A(110)=0.000                                                      ZPRS 114
C                                                                       ZPRS 115
C        COEFFICIENTS USED IN CALCULATING SPECIFIC HEATS AT CONSTANT    ZPRS 116
C      PRESSURE WHEN TEMPERATURE IS GREATER THAN 5000 DEGREES RANKINE.ZPRS 117
C      USED IN SUBROUTINE PRELIM.                                       ZPRS 118
      A(111)=-0.042200                                                  ZPRS 119
```

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      A(112)=7.0D 05
C
C        COEFFICIENTS USED IN BLUNT CONE PRESSURE DISTRIBUTIONS
C      FOR CONE HALF ANGLE ANGLE LESS THAN 20 DEGREES IN AERO.
      A(135)=3.2636563801
      A(136)=-1.5924494D1
      A(137)=2.1399829200
      A(138)=4.5075261400
      A(139)=-3.1997816500
      A(140)=1.1761463000
      A(141)=-4.0259657500
      A(142)=1.3371717900
      A(143)=-2.2675891AD-1
      A(144)=-4.7418269301
      A(145)=1.9959879401
      A(146)=-2.7538529300
      A(147)=-8.2600169500
      A(148)=5.0601641500
      A(149)=-1.4883057400
      A(150)=5.5800904500
      A(151)=-1.7966908500
      A(152)=2.5623783500-1
      A(153)=1.4426572001
      A(154)=-5.1270301300
      A(155)=3.7365588100-1
      A(156)=3.3502852200
      A(157)=-1.5080029200
      A(158)=4.7180038700-1
      A(159)=-1.8450126300
      A(160)=5.6953762200-1
      A(161)=-6.9064775900-2

C        COEFFICIENTS USED IN CALCULATING TSTAR IN SUBROUTINE DRAGCO.
      A(162)= 1.5276955003
      A(163)= 2.1398368900
      A(164)=-2.0710676300-4
      A(165)= 5.5210822100-9
      A(166)=-1.3149173703
      A(167)= 2.2819599200
      A(168)=-0.9534279700-4
      A(169)= 1.3648047800-7
      A(170)= 1.0995150502
      A(171)=-1.9134016600-1
      A(172)= 9.6485959200-5
      A(173)=-1.2079591500-8
C
C        COEFFICIENTS USED IN CALCULATING THE FREE MOLECULE DRAG
C      COEFFICIENT ON THE SPHERICAL NOSE.  USED IN SUBROUTINE DRAGCO.
      A(174)= 0.973660D0
      A(175)=-0.90732D-1
      A(176)=-0.30600D-1
      A(177)= 0.12427D-2
      A(178)= 0.11863D-1
      A(179)= 0.90475D-3
      A(180)=-0.45991D-2
      A(181)=-0.35747D-3
      A(182)=-0.10260D-2
      A(183)= 0.51253D-4
      A(184)=-0.13922D-3
      A(185)=-0.10141D-5
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      A(186)= 0.11221D-6
      A(187)=-0.39507D-6
      A(188)=-0.52692D-6
      A(189)= 0.37457D-7
      A(190)= 0.12721D-7
      A(191)=-0.12575D-8
      A(192)= 0.11965D-9
      A(193)= 0.14016D-10
C
C         COEFFICIENTS USED IN CALCULATING THE STRONG INTERACTION
C       DRAG COEFFICIENT FOR CONE HALF ANGLE LESS THAN 15 DEGREES.
C       USED IN SUBROUTINE DRAGCO.
      A(200)=-3.900218D0
      A(201)=0.5381002D0
      A(202)=0.1757743D0
      A(203)=0.1198765D-01
      A(204)=0.5518595D0
      A(205)=0.5159301D0
      A(206)=3.6956118-04
      A(207)=-0.6825327D-01
C
C         COEFFICIENTS USED IN DETERMINING THE BLUNT CONE FOREBODY
C       PRESSURE DRAG COEFFICIENT FOR CONE HALF ANGLE 4 TO 10 DEGREES
C       INCLUSIVE.  USED IN SUBROUTINE DRAGCO.
      A(211)=  2.8595862AD 1
      A(212)= -1.34187113D 1
      A(213)= -9.23446558D 1
      A(214)= -6.41572426D 1
      A(215)= -1.16902801D0
      A(216)=  1.69061561D0
      A(217)=  1.84003341D0
      A(218)= -2.69534673D0
      A(219)= -2.56644064D0
      A(220)= -3.56934177D0
      A(221)=  6.04477922D 1
      A(222)= -3.02793482D0
      A(223)= -7.90055127D0
      A(224)= -3.37637032D0
      A(225)= -7.59644519D61
      A(226)= -1.61023831D61
      A(227)=  2.32733898D61
      A(228)=  1.05707834D62
      A(229)= -1.60350777D61
      A(230)=  7.21995030D0
      A(231)= -2.93557270D61
      A(232)= -4.47557211D61
      A(233)= -8.06730866D61
      A(234)=  7.41452609D62
      A(235)=  9.57017875D61
      A(236)=  2.26645809D61
      A(237)= -1.13658624D63
      A(238)= -2.45554584D61
      A(239)= -2.97182558D61
      A(240)=  1.1842267D62
      A(241)=  7.81925829D61
      A(242)=  2.8903803D62
      A(243)= -1.81075999D63
      A(244)= -1.8052463D62
      A(245)= -2.56643271D62
      A(246)=  2.91438859D63
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C
C        COEFFICIENTS USED IN DETERMINING THE BLUNT CONE FOREBODY
C     PRESSURE DRAG COEFFICIENT FOR CONE HALF ANGLE GREATER THAN
C     10 AND LESS THAN OR EQUAL TO 20 DEGREES.  USED IN SUBROUTINE DR
      A(247)=  1.23436424D0
      A(248)= -9.60820651D-2
      A(249)=  4.94191856D-1
      A(250)= -4.1177211D-1
      A(251)=  4.57724856D0
      A(252)= -1.63991921D01
      A(253)=  1.94147610-1
      A(254)= -4.45326419D0
      A(255)=  2.73652736D01
      A(256)= -3.46601734D01
      A(257)=  1.17239946D01
      A(258)= -1.67160694D01
      A(259)=  1.36942532D01
      A(260)= -2.55101207D02
      A(261)=  8.22067481D02
      A(262)=  2.13249135D01
      A(263)=  3.30745665D02
      A(264)= -1.60046305D03
      A(265)=  3.62270139D02
      A(266)= -2.60915226D02
      A(267)=  3.67997492D02
      A(268)= -2.30076632D02
      A(269)=  6.19817135D03
      A(270)= -1.24624247D04
      A(271)= -3.11638604D01
      A(272)= -5.87052896D03
      A(273)=  2.3109465D04
      A(274)= -1.32594998D03
      A(275)=  1.31926394D03
      A(276)= -2.10638114D03
      A(277)=  1.21038384D03
      A(278)= -2.09572913D04
      A(279)= -6.10107009D04
      A(280)= -5.66578622D02
      A(281)=  2.99870747D04
      A(282)= -1.11802873D05
C
C        COEFFICIENTS USED IN DETERMINING THE SHAPE FACTOR FOR
C     CALCULATING LAMINAR-INDUCED-DRAG COEFFICIENT.  USED IN SUB-
C     ROUTINE DRAGCD.
      A(283)=-2.22717311D0
      A(284)=1.33222238D-1
      A(285)=3.99959300D-1
      A(286)=1.59299472D-1
      A(287)=-1.89752379D0
      A(288)=1.92415836D-1
      A(289)=7.95457767D-1
      A(290)=-1.13207402D-1
C
C        COEFFICIENTS USED IN CALCULATING THE TRANSITION ALTITUDE.
C     USED IN SUBROUTINE PRELIM.
      A(300)=2.4922926E04
      A(301)=9.9402976E03
      A(302)=-3.0976229E02
      A(303)=5.9957286E02
      A(304)=9.1039066E01
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      A(305)=-9.8957880D0                                              ZPRS 300
      A(306)=9.2654140D04                                              ZPRS 301
      A(307)= 1.2075950D06                                             ZPRS 302
      A(308)=2.1493710D02                                              ZPRS 303
      A(309)= 1.0943670D06                                             ZPRS 304
      A(310)=4.0713030D02                                              ZPRS 305
      A(311)=2.1394120D1                                               ZPRS 306
C                                                                      ZPRS 307
C        COEFFICIENTS USED IN DETERMINING THE BLUNT CONE FOREBODY      ZPRS 308
C      PRESSURE DRAG COEFFICIENT FOR CONE HALF ANGLE GREATER THAN      ZPRS 309
C      20 AND LESS THAN OR EQUAL TO 40 DEGREES.  USED IN SUBROUTINE    ZPRS 310
C      DRAGCO.                                                         ZPRS 311
      A(312)=  3.8975129D0                                             ZPRS 312
      A(313)= -5.9188305D0                                             ZPRS 313
      A(314)=  2.7339701D01                                            ZPRS 314
      A(315)= -3.7691133D0                                             ZPRS 315
      A(316)=  3.7055450D1                                             ZPRS 316
      A(317)= -1.2134098D02                                            ZPRS 317
      A(318)=  1.0532017D01                                            ZPRS 318
      A(319)= -5.9525534D01                                            ZPRS 319
      A(320)=  1.5035872D02                                            ZPRS 320
      A(321)= -2.0030109D02                                            ZPRS 321
      A(322)=  4.3788068D02                                            ZPRS 322
      A(323)= -2.0475531D03                                            ZPRS 323
      A(324)=  3.3700141D02                                            ZPRS 324
      A(325)= -3.0000752D03                                            ZPRS 325
      A(326)= -9.7002459D03                                            ZPRS 326
      A(327)= -9.5506307D02                                            ZPRS 327
      A(328)=  4.9393483D03                                            ZPRS 328
      A(329)= -1.2734599D04                                            ZPRS 329
      A(330)=  3.9230070D03                                            ZPRS 330
      A(331)= -1.0215051D04                                            ZPRS 331
      A(332)=  4.5599211D04                                            ZPRS 332
      A(333)= -9.6976564D03                                            ZPRS 333
      A(334)=  7.7204729D04                                            ZPRS 334
      A(335)= -2.5013418D05                                            ZPRS 335
      A(336)=  2.7603612D04                                            ZPRS 336
      A(337)= -1.3157469D05                                            ZPRS 337
      A(338)=  3.4007804D05                                            ZPRS 338
      A(339)= -2.5582199D04                                            ZPRS 339
      A(340)=  7.6899505D04                                            ZPRS 340
      A(341)= -3.9081014D05                                            ZPRS 341
      A(342)= -8.8103534D04                                            ZPRS 342
      A(343)= -6.428158D05                                             ZPRS 343
      A(344)=  2.0609052D06                                            ZPRS 344
      A(345)= -2.4955187D05                                            ZPRS 345
      A(346)=  1.1390533D06                                            ZPRS 346
      A(347)= -2.9314593D06                                            ZPRS 347
C                                                                      ZPRS 348
C        COEFFICIENTS USED IN DETERMINING THE RATIO COP WITH ANGLE     ZPRS 349
C      OF ATTACK EFFECTS/ COP FOR ANGLE OF ATTACK OF ZERO, WHERE       ZPRS 350
C      THE ABSOLUTE VALUE OF THE ANGLE OF ATTACK IS GREATER THAN 4 ANDZPRS 351
C      LESS THAN OR EQUAL TO 40 DEGREES.  IF THE ABSOLUTE VALUE OF     ZPRS 352
C      ALPHA IS GREATER THAN 40 DEGREES THEN ALPHA IS SET EQUAL TO 40.ZPRS 353
C      USED IN SUBROUTINE DRAGCO.                                      ZPRS 354
      A(348)= -8.9760619D-1                                            ZPRS 355
      A(349)=  3.4796363D-1                                            ZPRS 356
      A(350)=  1.2479244D0                                             ZPRS 357
      A(351)= -5.7600731D-1                                            ZPRS 358
      A(352)=  6.1471530D0                                             ZPRS 359
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      A(353)= -6.24155222D0                                              ZPRS 360
      A(354)=  1.0010310C                                                ZPRS 361
      A(355)=  7.2961478800-1                                            ZPRS 362
      A(356)= -3.21915365D-1                                             ZPRS 363
      A(357)=  1.60775264D0                                              ZPRS 364
      A(358)= -1.37411127D-1                                             ZPRS 365
      A(359)= -6.22070312D-1                                             ZPRS 366
      A(360)=  1.52746405D0                                              ZPRS 367
      A(361)= -9.9420884D0                                               ZPRS 368
      A(362)= -1.50246052D61                                             ZPRS 369
      A(363)=  5.06278184D0                                              ZPRS 370
      A(364)= -1.94995005D61                                             ZPRS 371
      A(365)=  1.09536438D61                                             ZPRS 372
      A(366)=  1.10434749D61                                             ZPRS 373
      A(367)= -6.27928094D0                                              ZPRS 374
      A(368)=  1.96390351D0                                              ZPRS 375
      A(369)= -1.17951227D61                                             ZPRS 376
      A(370)= -1.09185232D61                                             ZPRS 377
      A(371)=  4.64702279D0                                              ZPRS 378
      A(372)=  3.93475807D0                                              ZPRS 379
      A(373)= -2.41766079D61                                             ZPRS 380
      A(374)=  2.69771050D61                                             ZPRS 381
      A(375)= -8.31610988D0                                              ZPRS 382
      A(376)=  1.14410322D61                                             ZPRS 383
      A(377)=  1.41876889D61                                             ZPRS 384
      A(378)= -3.36511599D61                                             ZPRS 385
      A(379)= -1.27075372D61                                             ZPRS 386
      A(380)=  4.51823102D0                                              ZPRS 387
      A(381)= -3.64635942D61                                             ZPRS 388
      A(382)=  4.25988805D61                                             ZPRS 389
      A(383)= -1.35577778D61                                             ZPRS 390
C                                                                        ZPRS 391
C          COEFFICIENTS USED IN CALCULATING THE STRONG INTERACTION       ZPRS 392
C        DRAG COEFFICIENT FOR CONE HALF ANGLE GREATER THAN OR EQUAL TO   ZPRS 393
C        15 DEGREES.  USED IN SUBROUTINE DRAGCD.                         ZPRS 394
      A(384)=-1.1171445501                                               ZPRS 395
      A(385)=6.0333961000                                                ZPRS 396
      A(386)=1.2540995700                                                ZPRS 397
      A(387)=-6.9413359400-1                                             ZPRS 398
      A(388)=-4.8756628500-2                                             ZPRS 399
      A(389)=2.7593112200-2                                              ZPRS 400
      A(390)=6.4852995100-4                                              ZPRS 401
      A(391)=-3.7302674000-4                                             ZPRS 402
      A(392)=4.97741854D0                                                ZPRS 403
      A(393)=-2.99489699D0                                               ZPRS 404
      A(394)=-5.55817872D-1                                              ZPRS 405
      A(395)=3.54374761D-1                                               ZPRS 406
      A(396)=2.14499588D-2                                               ZPRS 407
      A(397)=-1.39691679D-2                                              ZPRS 408
      A(398)=-2.93985643D-4                                              ZPRS 409
      A(399)=1.82042957D-4                                               ZPRS 410
C                                                                        ZPRS 411
C          COEFFICIENTS USED TO DETERMINE COEFFICIENTS A(118),-A(119),   ZPRS 412
C        A(120) USED IN SUBROUTINE DRAGCD TO CALCULATE TURBULENT SKIN    ZPRS 413
C        FRICTION DRAG COEFFICIENT.                                      ZPRS 414
      A(400)=-0.30347E02                                                 ZPRS 415
      A(401)=0.28158E02                                                  ZPRS 416
      A(402)=-0.72955D6C1                                                ZPRS 417
      A(403)=0.120455E01                                                 ZPRS 418
      A(404)=-0.100240C                                                  ZPRS 419
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      A(405)=0.51120D-02                                                ZPRS 420
      A(406)=-0.96327D-04                                               ZPRS 421
      A(407)=0.57456D03                                                 ZPRS 422
      A(408)=-0.39260D03                                                ZPRS 423
      A(409)=0.11991D03                                                 ZPRS 424
      A(410)=-0.19641D02                                                ZPRS 425
      A(411)=0.17049D01                                                 ZPRS 426
      A(412)=-0.83945D-01                                               ZPRS 427
      A(413)=0.15912D-02                                                ZPRS 428
      A(414)=-0.20570D04                                                ZPRS 429
      A(415)=0.12804D04                                                 ZPRS 430
      A(416)=-0.37451D03                                                ZPRS 431
      A(417)=0.61556D02                                                 ZPRS 432
      A(418)=-0.56274D01                                                ZPRS 433
      A(419)=0.26611D00                                                 ZPRS 434
      A(420)=-0.50463D-02                                               ZPRS 435
C                                                                       ZPRS 436
C        COEFFICIENTS USED IN DETERMINING THE RATIO CDP WITH ANGLE     ZPRS 437
C     OF ATTACK EFFECTS/ CDP FOR ANGLE OF ATTACK OF ZERO, WHERE        ZPRS 438
C     THE ABSOLUTE VALUE OF ALPHA IS LESS THAN 4 DEGREES AND GREATER   ZPRS 439
C     THAN ZERO.  USED IN SUBROUTINE DRAGCO.                           ZPRS 440
      A(421)=  2.7958710D-1                                             ZPRS 441
      A(422)=  4.8545709D-3                                             ZPRS 442
      A(423)= -2.7058153D-4                                             ZPRS 443
      A(424)=  4.3295793D-6                                             ZPRS 444
      A(425)=  6.5285748D-1                                             ZPRS 445
      A(426)= -2.0114579D-1                                             ZPRS 446
      A(427)=  1.4953548D-2                                             ZPRS 447
      A(428)= -4.2125604D-4                                             ZPRS 448
      A(429)= -3.6441504D-2                                             ZPRS 449
      A(430)=  3.4095446D-2                                             ZPRS 450
      A(431)= -3.6745991D-3                                             ZPRS 451
      A(432)=  9.9011533D-5                                             ZPRS 452
      A(433)=  1.4992744D-1                                             ZPRS 453
      A(434)= -3.6104271D-2                                             ZPRS 454
      A(435)=  1.9323459D-3                                             ZPRS 455
      A(436)= -2.7315052D-5                                             ZPRS 456
      A(437)= -6.7486496D00                                             ZPRS 457
      A(438)=  2.0062417D00                                             ZPRS 458
      A(439)= -1.6725229D-1                                             ZPRS 459
      A(440)=  4.1667530D-3                                             ZPRS 460
      A(441)=  1.0731207D00                                             ZPRS 461
      A(442)= -4.2130050D-1                                             ZPRS 462
      A(443)=  3.9705345D-2                                             ZPRS 463
      A(444)= -1.0050228D-3                                             ZPRS 464
      A(445)= -2.6440550D-1                                             ZPRS 465
      A(446)=  4.7023793D-2                                             ZPRS 466
      A(447)= -2.4411453D-3                                             ZPRS 467
      A(448)=  3.5619831D-5                                             ZPRS 468
      A(449)=  1.4709719D1                                              ZPRS 469
      A(450)= -6.9620456D00                                             ZPRS 470
      A(451)=  4.1616283D-1                                             ZPRS 471
      A(452)= -1.0376190D-2                                             ZPRS 472
      A(453)= -3.4799198D00                                             ZPRS 473
      A(454)=  1.1459987D00                                             ZPRS 474
      A(455)= -9.9771064D-2                                             ZPRS 475
      A(456)=  2.5480289D-3                                             ZPRS 476
C                                                                       ZPRS 477
C        COEFFICIENTS USED IN DETERMINING THE BLUNTNESS CORRECTION     ZPRS 478
C     TO THE SKIN FRICTION DRAG COEFFICIENT IN SUBROUTINE DRAGCO.      ZPRS 479
```

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C        FOR A BLUNTNESS RATIO GREATER THAN OR EQUAL TO 0.2.              ZPRS 480
      A(457) = 9.09599981D-01                                              ZPRS 481
      A(458) = 1.33953866D-08                                              ZPRS 482
      A(459) =-3.39247271D-00                                              ZPRS 483
      A(460) = 3.59283188D-10                                              ZPRS 484
      A(461) =-1.36601870D-11                                              ZPRS 485
      A(462) = 8.58801823D+00                                              ZPRS 486
      A(463) =-6.51143480D+00                                              ZPRS 487
      A(464) = 2.47735029D+00                                              ZPRS 488
      A(465) =-3.64350270D-01                                              ZPRS 489
      A(466) = 1.69973239D-02                                              ZPRS 490
      A(467) =-7.77160227D+01                                              ZPRS 491
      A(468) = 6.96505884D+01                                              ZPRS 492
      A(469) =-2.11323256D+01                                              ZPRS 493
      A(470) = 2.63582113D+00                                              ZPRS 494
      A(471) =-1.11229610D-01                                              ZPRS 495
C        FOR A BLUNTNESS RATIO LESS THAN 0.2.                             ZPRS 496
      A(472) = 2.14018077D+00                                              ZPRS 497
      A(473) =-1.12954576D+00                                              ZPRS 498
      A(474) = 3.80856652D-01                                              ZPRS 499
      A(475) =-4.06886380D-02                                              ZPRS 500
      A(476) = 2.21265275D-03                                              ZPRS 501
      A(477) =-1.97107353D+01                                              ZPRS 502
      A(478) = 1.61930843D+01                                              ZPRS 503
      A(479) =-4.59456149D+00                                              ZPRS 504
      A(480) = 5.23362138D-01                                              ZPRS 505
      A(481) =-2.05329556D-02                                              ZPRS 506
      A(482) = 2.98504433D+01                                              ZPRS 507
      A(483) =-2.31135628D+01                                              ZPRS 508
      A(484) = 6.19713696D+00                                              ZPRS 509
      A(485) =-6.75613756D-01                                              ZPRS 510
      A(486) = 2.58207660D-02                                              ZPRS 511
C                                                                          ZPRS 512
C          COEFFICIENTS USED IN CALCULATING BASE DRAG COEFFICIENT IN      ZPRS 513
C        SUBROUTINE DRAGCO.                                                ZPRS 514
C        FOR FREE STREAM MACH NUMBER LESS THAN 7.                          ZPRS 515
      A(487)= 3.04562151D-1                                                ZPRS 516
      A(488)=-4.11272576D0                                                 ZPRS 517
      A(489)= 2.07395569D+1                                                ZPRS 518
      A(490)=-2.31947425D+1                                                ZPRS 519
      A(491)= 2.56526225D+1                                                ZPRS 520
      A(492)=-3.63933596D+2                                                ZPRS 521
      A(493)= 1.93266242D+3                                                ZPRS 522
      A(494)=-3.13904376D+3                                                ZPRS 523
      A(495)=-3.78069826D+2                                                ZPRS 524
      A(496)= 5.92284350D+3                                                ZPRS 525
      A(497)=-2.97409434D+1                                                ZPRS 526
      A(498)= 5.00082593D+4                                                ZPRS 527
C        FOR FREE STREAM MACH NUMBER GREATER THAN OR EQUAL TO 7.           ZPRS 528
      A(499)= 8.23705525D-1                                                ZPRS 529
      A(500)=-2.29600636D+1                                                ZPRS 530
      A(501)= 2.24767224D+2                                                ZPRS 531
      A(502)=-7.11667666D+2                                                ZPRS 532
      A(503)= 5.97333566D+1                                                ZPRS 533
      A(504)=-1.66016249D+3                                                ZPRS 534
      A(505)= 1.59623113D+4                                                ZPRS 535
      A(506)=-4.99067623D+4                                                ZPRS 536
      A(507)=-6.47120825D+2                                                ZPRS 537
      A(508)= 1.32995716D+4                                                ZPRS 538
      A(509)= 1.30043496D+5                                                ZPRS 539
```

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X(510)= 4.09475475065                                    ZPRS 540
RETURN                                                   ZPRS 541
END                                                      ZPRS 542
```

```
CZREADX
      SUBROUTINE ZREADX
      IMPLICIT REAL*8(A-H,O-Z)
C
C
C           SUBROUTINE ZREADX PROVIDES THE INFORMATION ABOUT THE SIZE
C         AND DIMENSION OF EACH INPUT VARIABLE IT REFERS TO.  THIS
C         INFORMATION IS REQUIRED BY THE INPUT SUBROUTINE READIN, A
C         LIBRARY ROUTINE.
C
C
      COMMON /CIOCUR/ IOCCUR(320)
       COMMON /CPOCUR/ POCUR(11700)
      COMMON /DPCSFC/ BZERO,BZ,B3,BTWEN,B24,DX,ZNUS,CNE,DS8,X2PCC,X38,
     1IND2,NSTWL
      COMMON /NALTFG/FGSM,NALT
      COMMON /NIMPUT/ AKW,RHOW,CRHCW,DELWH,       TABL,CHCHEM,RHCSL,
     1    RTO,RCON,ACON,       R21,R22,R23,       CNUMR(169)
      COMMON /IDNOS/ ID1(50), ID2(50)
      COMMON /IXCOM/ XCOM(200), ICOM(200)
      COMMON/SENSE/ISEN1,ISEN2
      COMMON/MIN/ALOW(20),UP(20), AMULT(20),CALOW(20),CTP(20)
      COMMON/IOPT/IPRCC,IN,NCONS,IPNT,IEX,LIMIT,IRAND
      COMMON/FOPT/ERR,PRAND, FAC, DELTA
      COMMON/DOPT/DELX(20)
      COMMON /TBLS12/ ERNTBL(8,10),ERNRTB(10),ERNUTB(8),
     1    ENTABL(25,9),ESTABL(9),HSTABL(25),
     2    ETABL(12,11),THTTBL(11),EMCTBL(12),
     3         D(11,5,4),XYZTBL(11,3)
      COMMON/BLKO/HH(1600),X(40),GXX(40),S(40),XP(40),TXX(40),
     1SP(40),GS,GSP,GTP,GSS,GTT,GSB,FZZ,FP,FB,FC,E,PZZ,TO,BS,SL,ZZZ,
     1ZZZ,AKK,EL,
     2DELXX,FAK,CXX(40,10)
C     WARNING - BLKO COMMON IS BEING SHARED BY DAVDON AND ROSBRK-GRAM
C     OPTIMIZERS
      COMMON/MINSK/N,K, ALB(20), UB(20),XX(20),FXX
      COMMON /MULT/ SPULT(25)
      COMMON /IGOHL/ IGOL(20), IGOH(20)
      COMMON/DWL/DVECT(20),WPF,LREF
      COMMON /CWAKE/ BETAZ,FRO1,FRO2,FRO3,PHI1,PHI2,PHI3,SIGNL1,SIGNL2,
     1SIGNL3,TAU1,TAU2,TAU3,WKALT,WSTALT,IND,IWAKE,IWPRNT
      COMMON OCCUR, NCCCUR
C
C
      DIMENSION OCCUR(4000), NCCCUR(30)
      DIMENSION AA(27),ACOP(140),BCR(40),BCD(40),BCV(40)
      DIMENSION BCWL1(40),BCWL2(40),BCWL3(40),BCWR1(40),BCWR2(40)
      DIMENSION TCWL1(40),TCWL2(40),TCWL3(40),TCWR1(40),TCWR2(40)
      DIMENSION WR2P(160),WR3P(160),ZPLCT(160)
      DIMENSION BETAZ(10),PHI1(10), PHI2(10), PHI3(10), WKALT(10)
       DIMENSION SWR3(40),TCR(40),TCD(40),TCV(40)
       DIMENSION NCOMCV(50),NPV(160),SR(40),SD(40),SRS(9),SV(40)
       DIMENSION SWL1(40),SWL2(40),SWL3(40),SWR1(40),SWR2(40)
       DIMENSION BCWR3(40),BETAPL(160),DVH(50),DVL(50),H(40),IOP(90)
       DIMENSION TCWR3(40),TPLCT(160),VOGPLT(160),VPLOT(160)
      DIMENSION          WL1P(160),WL2P(160),WL3P(160),WR1P(160)
C
C
      EQUIVALENCE (OCCUR(3543),CCON)
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                                                                  ZREAD 60
      EQUIVALENCE (PCCUR(11571), AA     )                         ZREAD 61
      EQUIVALENCE (PCCUR(00881), ACDP   )                         ZREAD 62
      EQUIVALENCE (PCCUR(05181), BCB    )                         ZREAD 63
      EQUIVALENCE (PCCUR(05101), BCD    )                         ZREAD 64
      EQUIVALENCE (PCCUR(06501), BCWL1  )                         ZREAD 65
      EQUIVALENCE (PCCUR(05581), BCWL2  )                         ZREAD 66
      EQUIVALENCE (PCCUR(04661), BCWL3  )                         ZREAD 67
      EQUIVALENCE (PCCUR(06261), BCWR1  )                         ZREAD 68
      EQUIVALENCE (PCCUR(05341), BCWR2  )                         ZREAD 69
      EQUIVALENCE (PCCUR(05421), BCWR3)                           ZREAD 70
      EQUIVALENCE (PCCUR(05021), BCV    )                         ZREAD 71
      EQUIVALENCE (PCCUR(00641), BETAPL)                          ZREAD 72
      EQUIVALENCE (PCCUR(11657), DVL    )                         ZREAD 73
      EQUIVALENCE (PCCUR(11607), DVH    )                         ZREAD 74
      EQUIVALENCE (PCCUR(05841), H      )                         ZREAD 75
      EQUIVALENCE (PCCUR(11757), PED    )                         ZREAD 76
      EQUIVALENCE (PCCUR(06821), SB     )                         ZREAD 77
      EQUIVALENCE (PCCUR(05781), SD     )                         ZREAD 78
      EQUIVALENCE (PCCUR(11558), SPS    )                         ZREAD 79
      EQUIVALENCE (PCCUR(05741), SV     )                         ZREAD 80
      EQUIVALENCE (PCCUR(06981), SWL1   )                         ZREAD 81
      EQUIVALENCE (PCCUR(07021), SWL2   )                         ZREAD 82
      EQUIVALENCE (PCCUR(07061), SWL3   )                         ZREAD 83
      EQUIVALENCE (PCCUR(06861), SWR1   )                         ZREAD 84
      EQUIVALENCE (PCCUR(06901), SWR2   )                         ZREAD 85
      EQUIVALENCE (PCCUR(05941), SWR3   )                         ZREAD 86
      EQUIVALENCE (PCCUR(06221), TCB    )                         ZREAD 87
      EQUIVALENCE (PCCUR(05141), TCD    )                         ZREAD 88
      EQUIVALENCE (PCCUR(06541), TCWL1  )                         ZREAD 89
      EQUIVALENCE (PCCUR(06621), TCWL2  )                         ZREAD 90
      EQUIVALENCE (PCCUR(06701), TCWL3  )                         ZREAD 91
      EQUIVALENCE (PCCUR(06301), TCWR1  )                         ZREAD 92
      EQUIVALENCE (PCCUR(05381), TCWR2  )                         ZREAD 93
      EQUIVALENCE (PCCUR(06461), TCWR3  )                         ZREAD 94
      EQUIVALENCE (PCCUR(05061), TCV    )                         ZREAD 95
      EQUIVALENCE (PCCUR(00001), TPLOT  )                         ZREAD 96
      EQUIVALENCE (PCCUR(00481), VOGPLT)                          ZREAD 97
      EQUIVALENCE (PCCUR(00321), VPLOT  )                         ZREAD 98
      EQUIVALENCE (PCCUR(01281), WL1P   )                         ZREAD 99
      EQUIVALENCE (PCCUR(01461), WL2P   )                         ZREAD100
      EQUIVALENCE (PCCUR(01501), WL3P   )                         ZREAD101
      EQUIVALENCE (PCCUR(00801), WR1P   )                         ZREAD102
      EQUIVALENCE (PCCUR(00961), WR2P   )                         ZREAD103
      EQUIVALENCE (PCCUR(01121), WR3P   )                         ZREAD104
      EQUIVALENCE (PCCUR(00161), ZPLOT  )                         ZREAD105
C                                                                 ZREAD106
      EQUIVALENCE (IOCCUR(00314), IOBL   )                        ZREAD107
      EQUIVALENCE (IOCCUR(00001), IOP    )                        ZREAD108
      EQUIVALENCE (IOCCUR(00301), IREF   )                        ZREAD109
      EQUIVALENCE (IOCCUR(00302), IPLOT  )                        ZREAD110
      EQUIVALENCE (IOCCUR(00303), MODE   )                        ZREAD111
      EQUIVALENCE (IOCCUR(00001), NCOMDV)                         ZREAD112
      EQUIVALENCE (IOCCUR(00304), NCP    )                        ZREAD113
      EQUIVALENCE (IOCCUR(00305), NOFCDV)                         ZREAD114
      EQUIVALENCE(IOCCUR(00306), NOVCH )                          ZREAD115
      EQUIVALENCE(IOCCUR(00307), NPA    )                         ZREAD116
       EQUIVALENCE (IOCCUR(00161), NPV    )                       ZREAD117
C                                                                 ZREAD118
C                                                                 ZREAD119
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C                                                                       ZREAD120
C                                                                       ZREAD121
      CALL SETUP(PHAA       ,P,AA,27)                                   ZREAD122
      CALL SETUP(9HACCE     ,P,ACCE,140)                                ZREAD123
      CALL SETUP ('ACCN     ',P,ACCN)                                   ZREAD124
      CALL SETUP ('AKW      ',P,AKW)                                    ZREAD125
      CALL SETUP( PHALOW       ,P, ALOW,20)                             ZREAD126
      CALL SETUP(PHAMULT    ,P,AMULT,20)                                ZREAD127
C                                                                       ZREAD128
      CALL SETUP(PHBCP      ,P,BCP,40)                                  ZREAD129
      CALL SETUP(PHBCD      ,P,BCD,40)                                  ZREAD130
      CALL SETUP ('BCCN     ',P,BCCN)                                   ZREAD131
      CALL SETUP(PHBCV      ,P,BCV,40)                                  ZREAD132
      CALL SETUP(PHBCWL1    ,P,BCWL1,40)                                ZREAD133
      CALL SETUP(PHBCWL2    ,P,BCWL2,40)                                ZREAD134
      CALL SETUP(PHBCWL3    ,P,BCWL3,40)                                ZREAD135
      CALL SETUP(PHBCWP1    ,P,BCWP1,40)                                ZREAD136
      CALL SETUP(PHBCWP2    ,P,BCWP2,40)                                ZREAD137
      CALL SETUP(PHBCWP3    ,P,BCWP3,40)                                ZREAD138
      CALL SETUP(PHBETAPL   ,P,BETAPL,160)                              ZREAD139
      CALL SETUP(PHBETAZ    ,P,BETAZ,10)                                ZREAD140
      CALL SETUP(PHBTWEN    ,P,BTWEN)                                   ZREAD141
      CALL SETUP(PHBZERO    ,P,BZERO)                                   ZREAD142
      CALL SETUP(PHB2       ,P,B2)                                      ZREAD143
      CALL SETUP(PHB3       ,P,B3)                                      ZREAD144
      CALL SETUP ('B21      ',P,B21)                                    ZREAD145
      CALL SETUP ('B22      ',P,B22)                                    ZREAD146
      CALL SETUP ('B23      ',P,B23)                                    ZREAD147
      CALL SETUP(PHB24      ,P,B24)                                     ZREAD148
C                                                                       ZREAD149
      CALL SETUP( PHCALOW       ,P, CALOW,20)                           ZREAD150
      CALL SETUP ('CCCN     ',P,CCCN)                                   ZREAD151
      CALL SETUP(PHCNP      ,P,CNP)                                     ZREAD152
      CALL SETUP ('CNUMB    ',P,CNUMB,169)                              ZREAD153
      CALL SETUP ('CPHOW    ',P,CPHOW)                                  ZREAD154
      CALL SETUP(PHCTP      ,P,CTP,20)                                  ZREAD155
C                                                                       ZREAD156
      CALL SETUP(PHDELTA       ,P,DELTA )                               ZREAD157
      CALL SETUP ('DELWH    ',P,DELWH)                                  ZREAD158
      CALL SETUP(PHDELX        ,P,DELX,20)                              ZREAD159
      CALL SETUP ('DHCHEM   ',P,DHCHEM)                                 ZREAD160
      CALL SETUP(PHDSR      ,P,DSR)                                     ZREAD161
      CALL SETUP ('DTABL    ',P,D,11,5,4)                               ZREAD162
      CALL SETUP(PHDVH      ,P,DVH,50)                                  ZREAD163
      CALL SETUP(PHDVL      ,P,DVL,50)                                  ZREAD164
      CALL SETUP(PHDX       ,P,DX)                                      ZREAD165
C                                                                       ZREAD166
      CALL SETUP ('EMCTRL   ',P,EMCTRL,12)                              ZREAD167
      CALL SETUP ('ENTABL   ',P,ENTABL, 25,9)                           ZREAD168
      CALL SETUP ('ERNPTB   ',P,ERNPTB,10)                              ZREAD169
      CALL SETUP ('ERNTBL   ',P,ERNTBL,8,10)                            ZREAD170
      CALL SETUP ('ERNUTR   ',P,ERNUTR,8)                               ZREAD171
      CALL SETUP(PHERR         ,P,ERR  )                                ZREAD172
      CALL SETUP ('ETABL    ',P,ETABL,12,11)                            ZREAD173
C                                                                       ZREAD174
      CALL SETUP(PHFAC         ,P,FAC    )                              ZREAD175
      CALL SETUP(PHFRSM     ,P,FRSM)                                    ZREAD176
      CALL SETUP(PHFR01     ,P,FR01)                                    ZREAD177
      CALL SETUP(PHFR02     ,P,FR02)                                    ZREAD178
      CALL SETUP(PHFR03     ,P,FR03)                                    ZREAD179
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C                                                          ZREAD180
      CALL SETUP(8HH       ,8,H,40)                        ZREAD181
      CALL SETUP(8HHH      ,8,HH,1600)                     ZREAD182
      CALL SETUP ('HSTABL  ',8,HSTABL,25)                  ZREAD183
C                                                          ZREAD184
      CALL SETUP(8HICCM    ,4,ICCM,200)                    ZREAD185
      CALL SETUP(8HIDBL    ,4,IDBL)                        ZREAD186
      CALL SETUP(8HIDND    ,4, ID1,50)                     ZREAD187
      CALL SETUP(8HIDC     ,4,ID2, 50)                     ZREAD188
      CALL SETUP(8HIEX     ,4,IEX  )                       ZREAD189
      CALL SETUP(8HIGCH    ,4,IGCH,20)                     ZREAD190
      CALL SETUP(8HIGCL    ,4,IGCL,20)                     ZREAD191
      CALL SETUP(8HIN      ,4,IN  )                        ZREAD192
      CALL SETUP ('IND     ',4,IND1)                       ZREAD193
      CALL SETUP(8HIND2    ,4,IND2)                        ZREAD194
      CALL SETUP(8HIOP     ,4,IOP,80)                      ZREAD195
      CALL SETUP(8HIPNT    ,4,IPNT)                        ZREAD196
      CALL SETUP(8HIPROC   ,4,IPROC)                       ZREAD197
      CALL SETUP(8HIRAND   ,4,IRAND)                       ZREAD198
      CALL SETUP(8HIREF    ,4,IREF)                        ZREAD199
      CALL SETUP(8HISEN1   ,4,ISEN1)                       ZREAD200
      CALL SETUP(8HISEN2   ,4,ISEN2)                       ZREAD201
      CALL SETUP(8HIWAKE   ,4,IWAKE)                       ZREAD202
      CALL SETUP(8HIWPRNT  ,4,IWPRNT)                      ZREAD203
C                                                          ZREAD204
      CALL SETUP(8HK       ,4, K)                          ZREAD205
C                                                          ZREAD206
      CALL SETUP(8HLIMIT   ,4,LIMIT)                       ZREAD207
      CALL SETUP(8HLPLOT   ,4,LPLOT)                       ZREAD208
      CALL SETUP(8HLRED    ,4,LRED)                        ZREAD209
C                                                          ZREAD210
      CALL SETUP(8HMODE    ,4,MODE)                        ZREAD211
C                                                          ZREAD212
      CALL SETUP(8HNALT    ,4,NALT)                        ZREAD213
      CALL SETUP(8HNCCMDV  ,4,NCCMDV,80)                   ZREAD214
      CALL SETUP(8HNCCNS   ,4,NCCNST)                      ZREAD215
      CALL SETUP(8HNCP     ,4,NCP)                         ZREAD216
      CALL SETUP(8HNDECDV  ,4,NDECDV)                      ZREAD217
      CALL SETUP(8HNDVCH   ,4,NDVCH)                       ZREAD218
      CALL SETUP(8HNPA     ,4,NPA)                         ZREAD219
      CALL SETUP(8HNPV     ,4,NPV,1AC)                     ZREAD220
      CALL SETUP(8HNSTWL   ,4,NSTWL)                       ZREAD221
C                                                          ZREAD222
      CALL SETUP(8HOVECT   ,8,OVECT,20)                    ZREAD223
C                                                          ZREAD224
      CALL SETUP(8HPEC     ,8,PEC)                         ZREAD225
      CALL SETUP(8HPHI1    ,8,PHI1 ,10)                    ZREAD226
      CALL SETUP(8HPHI2    ,8,PHI2 ,10)                    ZREAD227
      CALL SETUP(8HPHI3    ,8,PHI3 ,10)                    ZREAD228
      CALL SETUP(8HPRAND   ,8,PRAND)                       ZREAD229
C                                                          ZREAD230
      CALL SETUP ('RHOSL   ',8,RHOSL)                      ZREAD231
      CALL SETUP ('RHOW    ',8,RHOW)                       ZREAD232
      CALL SETUP ('RSTABL  ',8,RSTABL,9)                   ZREAD233
      CALL SETUP ('RTO     ',8,RTO)                        ZREAD234
C                                                          ZREAD235
      CALL SETUP(8HSP      ,8,SP,40)                       ZREAD236
      CALL SETUP(8HSC      ,8,SC,40)                       ZREAD237
      CALL SETUP(8HSIGNL1  ,8,SIGNL1)                      ZREAD238
      CALL SETUP(8HSIGNL2  ,8,SIGNL2)                      ZREAD239
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      [illegible]                                               ZREAD238
      CALL SETUP(8HSIGNL1     ,8,SIGNL1)                        ZREAD239
      CALL SETUP(8HSIGNL2     ,8,SIGNL2)
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      CALL SETUP(8HSIGNL3     ,8,SIGNL3)                        ZREAD240
      CALL SETUP(8HSMULT      ,8,SMULT,25)                      ZREAD241
      CALL SETUP(8HSRS        ,8,SRS,5)                         ZREAD242
      CALL SETUP(8HSV         ,8,SV,40)                         ZREAD243
      CALL SETUP(8HSWL1       ,8,SWL1,40)                       ZREAD244
      CALL SETUP(8HSWL2       ,8,SWL2,40)                       ZREAD245
      CALL SETUP(8HSWL3       ,8,SWL3,40)                       ZREAD246
      CALL SETUP(8HSWR1       ,8,SWR1,40)                       ZREAD247
      CALL SETUP(8HSWR2       ,8,SWR2,40)                       ZREAD248
      CALL SETUP(8HSWR3       ,8,SWR3,40)                       ZREAD249
                                                                ZREAD250
      CALL SETUP ('TABL       ',8,TABL)                         ZREAD251
      CALL SETUP(8HTAU1       ,8,TAU1)                          ZREAD252
      CALL SETUP(8HTAU2       ,8,TAU2)                          ZREAD253
      CALL SETUP(8HTAU3       ,8,TAU3)                          ZREAD254
      CALL SETUP(8HTCB        ,8,TCB,40)                        ZREAD255
      CALL SETUP(8HTCP        ,8,TCP,40)                        ZREAD256
      CALL SETUP(8HTCV        ,8,TCV,40)                        ZREAD257
      CALL SETUP(8HTCWL1      ,8,TCWL1,40)                      ZREAD258
      CALL SETUP(8HTCWL2      ,8,TCWL2,40)                      ZREAD259
      CALL SETUP(8HTCWL3      ,8,TCWL3,40)                      ZREAD260
      CALL SETUP(8HTCWR1      ,8,TCWR1,40)                      ZREAD261
      CALL SETUP(8HTCWR2      ,8,TCWR2,40)                      ZREAD262
      CALL SETUP(8HTCWR3      ,8,TCWR3,40)                      ZREAD263
      CALL SETUP ('THTTBL     ',8,THTTBL,11)                    ZREAD264
      CALL SETUP(8HTPLOT      ,8,TPLOT,160)                     ZREAD265
                                                                ZREAD266
      CALL SETUP(8HUP         ,8, UP,20)                        ZREAD267
                                                                ZREAD268
      CALL SETUP(8HVPLOT      ,8,VPLOT,160)                     ZREAD269
      CALL SETUP(8HVOGPLT     ,8,VOGPLT,160)                    ZREAD270
C                                                               ZREAD271
      CALL SETUP(8HWKALT      ,8,WKALT,10)                      ZREAD272
      CALL SETUP(8HWL1P       ,8,WL1P,160)                      ZREAD273
      CALL SETUP(8HWL2P       ,8,WL2P,160)                      ZREAD274
      CALL SETUP(8HWL3P       ,8,WL3P,160)                      ZREAD275
      CALL SETUP(8HWRF        ,8,WRF)                           ZREAD276
      CALL SETUP(8HWR1P       ,8,WR1P,160)                      ZREAD277
      CALL SETUP(8HWR2P       ,8,WR2P,160)                      ZREAD278
      CALL SETUP(8HWR3P       ,8,WR3P,160)                      ZREAD279
      CALL SETUP(8HWSTALT     ,8,WSTALT)                        ZREAD280
C                                                               ZREAD281
      CALL SETUP(8HXCOM       ,8,XCOM,200)                      ZREAD282
      CALL SETUP ('XDTABL     ',8,XYZTBL,11)                    ZREAD283
      CALL SETUP(8HX2BOD      ,8,X2BOD)                         ZREAD284
      CALL SETUP(8HX3B        ,8,X3B)                           ZREAD285
                                                                ZREAD286
      CALL SETUP ('YDTABL     ',8,XYZTBL(1,2), 11)              ZREAD287
C                                                               ZREAD288
      CALL SETUP ('ZDTABL     ',8,XYZTBL(1,3), 11)              ZREAD289
      CALL SETUP(8HZNUS       ,8,ZNUS)                          ZREAD290
      CALL SETUP(8HZPLOT      ,8,ZPLOT,160)                     ZREAD291
C                                                               ZREAD292
      RETURN                                                    ZREAD293
      END                                                       ZREAD294
```

```
CACOS
      IMPLICIT REAL*8 (A-H,O-Z)
CJACOS  ACOS  ACOSR  ACOSD
      REAL FUNCTION ACOSR*8(W)
      ENTRY ACOS(W)
C   THE ANGLE RETURNED WILL BE BETWEEN 0 AND PIE
      D = 1.0D0
    2 WS = 1.0D0 - W * W
      ACOSR = ATANQR (DSQRT(WS),W) / D
    3 RETURN
      ENTRY ACOSD(W)
      D = .1745329251994329D-1
      GO TO 2
      END
```

```
CASIN
      IMPLICIT REAL*8 (A-H,O-Z)
CJASIN  ASIN  ASINR  ASIND
      REAL FUNCTION ASINR*8(W)
      ENTRY ASIN(W)
C  THE ANGLE RETURNED WILL BE BETWEEN 0 AND PIE/2 OR 3*PIE/2 AND 2*PIE
      D = 1.0D0
    2 WS = 1.0D0 - W * W
      ASINR = ATANOR (W,DSQRT(WS)) / D
    3 RETURN
      ENTRY ASIND(W)
      D = .1745329251994329D-1
      GO TO 2
      END
```

```
CATAN
      IMPLICIT REAL*8 (A-H,O-Z)
CJTNQR  ATANQR  ATANQD
      REAL FUNCTION ATANQR*8(W,H)
      ENTRY ATANQ(W,H)
      D = 1.0D0
  110 X = DATAN2 (W,H)
      IF (X) 1, 2, 2
    1 X = X+6.283185307179586
    2 ATANQR = X / D
    4 RETURN
      ENTRY ATANQD(W,H)
      D = .1745329251994329D-1
      GO TO 110
      END
```

```
CENDJOB
      SUBROUTINE ENDJOB
C
C     ENDJOB IS A DUMMY SUBROUTINE
C
      RETURN
      END
```

```
CEZPLT
      SUBROUTINE EZPLT
C
C          EZPLT IS A DUMMY SUBROUTINE
C
      RETURN
      END
```

```
CFERROR                                                                 FERRO   1
      SUBROUTINE FERROR                                                 FERRO   2
C                                                                       FERRO   3
C     FERROR IS A DUMMY SUBROUTINE                                      FERRO   4
C                                                                       FERRO   5
      RETURN                                                            FERRO   6
      END                                                               FERRO   7
```

```
CFRAMEV                                                              FRAME  1
      SUBROUTINE FRAMEV                                              FRAME  2
C                                                                    FRAME  3
C     FRAMEV IS A DUMMY SUBROUTINE                                   FRAME  4
C                                                                    FRAME  5
      RETURN                                                         FRAME  6
      END                                                            FRAME  7
```

```
CIDFRMV                                                                IDFRM   1
      SUBROUTINE IDFRMV                                                IDFRM   2
C                                                                      IDFRM   3
C     IDFRMV IS A DUMMY SUBROUTINE                                     IDFRM   4
C                                                                      IDFRM   5
      RETURN                                                           IDFRM   6
      END                                                              IDFRM   7
```

```
CMIBCOM                                                          MIBCO  1
      SUBROUTINE MIBCOM                                          MIBCO  2
C                                                                MIBCO  3
C     MIBCOM IS A DUMMY SUBROUTINE                               MIBCO  4
C                                                                MIBCO  5
      RETURN                                                     MIBCO  6
      END                                                        MIBCO  7
```

```
CPLTND
      SUBROUTINE PLTND
C
C     PLTND IS A DUMMY SUBROUTINE
C
      RETURN
      END
```

```
READ     TITLE -                                      VARIABLE FIELD INPUT ROUTINEXEAD
                 S FØR 0S/360-                                                  EAD
         PRINT ØN,DATA,GEN                                                      EAD
         MACRØ                                                                  EAD
+NAME    CØL72 +HØW,+TØ                                                         EAD
+NAME    LA    RC,1)0,RC*         INCREMENT CØLUMN CØUNTER                      EAD
         CR    RC,RCMAX           SEE IF CØLUMN 72 HAS BEEN REACHED             EAD
         B+HØW +TØ                BRANCH ACCØRDINGLY                            EAD
         MEND                                                                   EAD
         MACRØ                                                                  EAD
+NAME    CØMP  +WITH,+HØW,+TØ                                                   EAD
+NAME    CLI   0)RC*,+WITH        EXAMINE THE CHARACTER ØN THE CARD             EAD
         B+HØW +TØ                BRANCH ACCØRDINGLY                            EAD
         MEND                                                                   EAD
         MACRØ                                                                  EAD
+NAME    CHECK +REG,+HØW,+TØ                                                    EAD
+NAME    LTR   +REG,+REG          TEST REGISTER                                 EAD
         B+HØW +TØ                BRANCH ACCØRDINGLY                            EAD
         MEND                                                                   EAD
         MACRØ                                                                  EAD
+NAME    CNV   +LØC                                                             EAD
+NAME    UNPK  +LØC,)2*,D8,6)2*   UNPACK FØR PRINTING                           EAD
         ØI    +LØC,,1,X-FO-      DELETE SIGN                                   EAD
         MEND                                                                   EAD
         MACRØ                                                                  EAD
+NAME    CØNV  +REG,+LØC                                                        EAD
+NAME    SLL   +REG,4             HALF-BYTE SHIFT TØ MAKE RØØM FØR SIGN         EAD
         ST    +REG,D8,4          STØRE IN RIGHT HALF ØF DØUBLE WØRD            EAD
         ØI    D8,7,X-0C-         INSERT PLUS SIGN                              EAD
         CNV   +LØC                                                             EAD
         MEND                                                                   EAD
LA000000 START 0                                                                EAD
         ENTRY READIN,WHERE,SETUP,HEDING                                        EAD
         EXTRN EXIT,FDXPI=,IUCØM=                                               EAD
         EJECT                                                                  EAD
*        SUBRØUTINE READIN)INCØL1* ØR READIN)INCØL1,** WHEN INCØL1=8888         EAD
*        A. L. ATKINSØN, R430, AUGUST 1966. BAL VERSIØN - JUNE 1967             EAD
*        LATEST MØDIFICATIØN  -  9 FEBRUARY 1968                                EAD
         SPACE 2                                                                EAD
READIN   BC    15,12)0,15*        BRANCH ARØUND ID                              EAD
         DC    XL2-0700-                                                        EAD
         DC    CL6-READIN-                                                      EAD
         STM   14,12,12)13*       SAVE REGISTERS                                EAD
         L     RW,0)0,1*          PICK UP ADDRESS ØF INCØL1                     EAD
         LR    12,15              PICK UP PRØGRAM BASE REGISTER                 EAD
         USING READIN,12          INFØRM ASSEMBLER ØF PRØGRAM BASE REGISTER     EAD
         L     RD,ADATA           PICK UP BASE REGISTER FØR PRØGRAM DATA        EAD
         USING DATA,RD            INFØRM ASSEMBLER ØF THAT BASE REGISTER        EAD
         LR    4,13               PICK UP ADDRESS ØF ØLD SAVE AREA              EAD
         LA    13,SAVE            PICK UP ADDRESS ØF NEW SAVE AREA              EAD
         ST    13,8)0,4*          SAVE ADDRESS ØF NEW SAVE AREA IN ØLD ØNE      EAD
         ST    4,SAVE,4           SAVE ADDRESS ØF ØLD SAVE AREA IN NEW ØNE      EAD
         ST    RW,ADINCØL1        SAVE ADDRESS ØF INCØL1                        EAD
STARTØLD NØP   STARTNEW                                                         EAD
         LH    RT,NUMTAB                                                        EAD
         CHECK RT,NP,ERRØR1       SEE IF THE INPUT TABLE WAS CØNSTRUCTED        EAD
         L     RW,0)0,RW*         PICK UP INCØL1                                EAD
         C     RW,C8888           WAS IT INITIALIZED TØ 8888                    EAD
         BNE   SKIP               IF NØT, BRANCH ARØUND                         EAD
         MVI   IEND,1,X-00-       SET NØN-STANDARD RETURN SWITCH                EAD
```

```
SKIP     MVI   STARTØLD,1,X-F0-                                         EAD   61
STARTNEW SR    RA,RA                                                    EAD   62
         ST    RA,INCØL1        ZERØ ØUT INCØL1 '                       EAD   63
         LA    RCMAX,CARD,71 PICK UP ADDRESS ØF CARD CØLUMN 72          EAD   64
TITLE    NØP   NEXTCARD                                                 EAD   65
         SDR   0,0                                                      EAD   66
         STD   0,D8             CLEAR DØUBLE WØRD                       EAD   67
         TIME  DEC              PICK UP TIME AND DATE                   EAD   68
         ST    1,DATE                                                   EAD   69
         SR    1,1                                                      EAD   70
         SRDL  0,24             ØBTAIN HØURS                            EAD   71
         CØNV  0,HRS            CØNVERT FØR PRINTING                    EAD   72
         CVB   0,D8             CØNVERT TØ BINARY                       EAD   73
         C     0,=F-10-                                                 EAD   74
         BNL   ØKK              IF LESS THAN TEN,                       EAD   75
         MVI   HRS,X-40-            INSERT BLANK ØN LEFT                EAD   76
ØKK      SR    0,0                                                      EAD   77
         SLDL  0,8              ØBTAIN MINUTES                          EAD   78
         CØNV  0,MNS            CØNVERT FØR PRINTING                    EAD   79
         SR    0,0                                                      EAD   80
         SLDL  0,8              ØBTAIN SECØNDS                          EAD   81
         CØNV  0,SCS            CØNVERT FØR PRINTING                    EAD   82
         SR    0,0                                                      EAD   83
         SLDL  0,8              ØBTAIN HUNDREDTHS ØF A SECØND           EAD   84
         CØNV  0,HSC                                                    EAD   85
         SDR   0,0                                                      EAD   86
         STD   0,D8                                                     EAD   87
         L     5,DATE                                                   EAD   88
         LR    1,5                                                      EAD   89
         STH   5,D8,6           ØBTAIN DAY ØF THE YEAR                  EAD   90
         CVB   5,D8             CØNVERT TØ BINARY INTEGER               EAD   91
         SRL   1,16             ØBTAIN YEAR                             EAD   92
         CØNV  1,YR             CØNVERT FØR PRINTING                    EAD   93
         CVB   2,D8             CØNVERT TØ A BINARY INTEGER             EAD   94
         SR    6,6              MØNTH CØUNTER                           EAD   95
         LR    3,6                                                      EAD   96
         SRDL  2,2              DIVIDE YEAR BY FØUR                     EAD   97
         LTR   3,3              IS THIS A LEAP YEAR                     EAD   98
         LA    2,4              INDEXING FØR SEARCH FØR MØNTH           EAD   99
         LA    3,44                                                     EAD  100
         BNZ   NØLEAP                                                   EAD  101
         C     5,=F-60-         CHECK FØR FEBRUARY 29TH                 EAD  102
         BL    NØLEAP                                                   EAD  103
         BH    LEAP                                                     EAD  104
FEB29    LA    6,2                                                      EAD  105
         LA    5,29                                                     EAD  106
         B     DØNE                                                     EAD  107
LEAP     LA    6,8              MØNTH IS MARCH, AT LEAST                EAD  108
         BCTR  5,0              REDUCE DATE TØ ACCØUNT FØR LEAP YEAR    EAD  109
NØLEAP   C     5,JAN(6)         CØMPARE WITH LAST DAY ØF THE MØNTH      EAD  110
         BNH   MØNTH            FØUND THE MØNTH                         EAD  111
         BXLE  6,2,NØLEAP       LØØP AGAIN                              EAD  112
MØNTH    S     5,INCØL1(6)      CØNVERT TØ DAY ØF MØNTH                 EAD  113
         SRL   6,2              ØBTAIN NUMBER                           EAD  114
         LA    6,1(0,6)             ØF MØNTH                            EAD  115
DØNE     CVD   5,D8             CØNVERT DAY ØF MØNTH TØ DECIMAL         EAD  116
         CNV   DAY              CØNVERT FØR PRINTING                    EAD  117
         CVD   6,D8             CØNVERT MØNTH TØ DECIMAL                EAD  118
         CNV   MTH              CØNVERT FØR PRINTING                    EAD  119
```

```
         C       6,=F-10-                                                EAD 120
         BNL     ØK               IF LESS THAN TEN,                      EAD 121
         MVI     MTH,X-40-          INSERT BLANK ØN LEFT                 EAD 122
ØK       L       15,VIBCØM        WRITE HEADING FØR A NEW PAGE ØF DATA   EAD 123
         CNØP    0,4                                                     EAD 124
         BAL     14,4)0,15*                                              EAD 125
         DC      F-6-                                                    EAD 126
         DC      A)F1*                                                   EAD 127
         BAL     14,16)0,15*                                             EAD 128
NEXTCARD L       RW,INCØL1        PICK UP INCØL1                         EAD 129
         CHECK   RW,P,RESTØRE     SEE IF CARD WAS A TRANSFER CARD        EAD 130
READCARD L       15,VIBCØM                                               EAD 131
         CNØP    0,4                                                     EAD 132
         BAL     14,0)0,15*       READ A CARD                            EAD 133
         DC      F-5-                                                    EAD 134
         DC      A)F2*                                                   EAD 135
         BAL     14,12)0,15*                                             EAD 136
         DC      A)CARD*                                                 EAD 137
         DC      XL4-0860000A-                                           EAD 138
         BAL     14,16)0,15*                                             EAD 139
PRINT    NØP     START                                                   EAD 140
         BAL     14,4)0,15*       WRITE THE CARD                         EAD 141
         DC      F-6-                                                    EAD 142
         DC      A)F3*                                                   EAD 143
         BAL     14,12)0,15*                                             EAD 144
         DC      A)CARD*                                                 EAD 145
         DC      XL4-0860000A-                                           EAD 146
         BAL     14,16)0,15*                                             EAD 147
START    LA      RC,CARD          PICK UP ADDRESS ØF CARD CØLUMN 1       EAD 148
         SR      R5,R5            ZERØ ØUT INCREMENTING FLAG             EAD 149
NFLAG    NØP     ACARD2                                                  EAD 150
         CØMP    BLANK,E,ETC      EXAMINE FIRST CHARACTER ØN THE CARD    EAD 151
         CØMP    E,E,IEND                                                EAD 152
         CØMP    H,E,HCARD                                               EAD 153
         CØMP    Z,E,HEXCARD                                             EAD 154
         CØMP    X,E,HEXCARD                                             EAD 155
         CØMP    A,E,ACARD                                               EAD 156
         CØMP    DØLLAR,E,READCARD                                       EAD 157
         CØMP    STAR,E,READCARD                                         EAD 158
         CØMP    N,E,NNNN                                                EAD 159
         CØMP    F,E,FFFF                                                EAD 160
         CØMP    P,E,PPPP                                                EAD 161
         CØMP    ZERØ,NH,ETC                                             EAD 162
         NI      0)RC*,X-0F-       ØBTAIN DIGIT FRØM TRANSFER CARD       EAD 163
         SR      RW,RW                                                   EAD 164
         IC      RW,0)0,RC*                                              EAD 165
         ST      RW,INCØL1         STØRE IT IN INCØL1                    EAD 166
ETC      LA      RC,1)0,RC*        INCREMENT CØLUMN CØUNTER              EAD 167
NEWFIELD CR      RC,RCMAX          LØØK FØR A NEW FIELD                  EAD 168
         BH      NEXTCARD                                                EAD 169
S10      CØMP    BLANK,E,NEXT     EXAMINE NEXT CHARACTER ØN THE CARD     EAD 170
         CØMP    CØMMA,E,NEXT                                            EAD 171
         CØMP    EQ029,E,NEXT                                            EAD 172
         CØMP    EQ026,NE,CHAR1                                          EAD 173
NEXT     CØL72   NH,S10                                                  EAD 174
S9       B       NEXTCARD                                                EAD 175
NNNN     CLC     0)7,RC*,NØPRINT                                         EAD 176
         BE      NØPRINTS                                                EAD 177
         CLC     0)6,RC*,NØFLIP                                          EAD 178
```

```
          BNE   ETC                                                  EAD 179
          MVI   F1.3,X-F0-    SUPPRESS PAGE FLIP FØR EACH CASE       EAD 180
          B     READCARD                                             EAD 181
NØPRINTS  MVI   PRINT.1,X-F0- SUPPRESS PRINTING ØF DATA CARDS        EAD 182
          MVI   TITLE.1,X-F0-                                        EAD 183
          B     READCARD                                             EAD 184
FFFF      CLC   014,RC*,FLIP                                         EAD 185
          BNE   ETC                                                  EAD 186
          MVI   F1.3,X-F1-    FLIP PAGE FØR EACH CASE                EAD 187
          B     READCARD                                             EAD 188
PPPP      CLC   015,RC*,PRINTS                                       EAD 189
          BNE   ETC                                                  EAD 190
          MVI   PRINT.1,X-00- PRINT DATA CARDS                       EAD 191
          MVI   TITLE.1,X-00-                                        EAD 192
          B     READCARD                                             EAD 193
ADATA     DC    A)DATA*                                              EAD 194
CHAR1     MVI   LØG.1,X-00-   EXAMINE FIRST CHARACTER IN NEW FIELD   EAD 195
          SR    RS,RS         ZERØ ØUT DECIMAL PØINT LØCATØR         EAD 196
          LR    RB,RS         ZERØ ØUT EXPØNENT LØCATØR              EAD 197
          CØMP  ZERØ,NL,S503  CHECK FØR NUMERIC                      EAD 198
          CØMP  A,NL,LETTER   CHECK FØR ALPHABETIC                   EAD 199
          CØMP  DØLLAR,E,LETTER DØLLAR SIGN IS ALPHABETIC            EAD 200
          CØMP  MINUS,E,S510                                         EAD 201
          CØMP  SLASH,E,ALPHA                                        EAD 202
          CØMP  LP026,E,SUBSCRPT                                     EAD 203
          CØMP  LP029,E,SUBSCRPT                                     EAD 204
          CØMP  DECIMAL,E,S508                                       EAD 205
          CØMP  PLUS026,E,S509                                       EAD 206
          CØMP  PLUS029,E,S509                                       EAD 207
          B     ERRØR                                                EAD 208
          EJECT                                                      EAD 209
*         NUMERIC FIELD                                              EAD 210
          SPACE 2                                                    EAD 211
S508      MVI   SIGN.1,X-C0-  DECIMAL PØINT, SET SIGN PLUS           EAD 212
          MVI   LØG.1,X-F0-   INITIALIZE LØGICAL FLAG                EAD 213
S5080     CHECK RS,NZ,ERRØR   CHECK FØR MØRE THAN ØNE DECIMAL PØINT  EAD 214
          LR    RS,RC         SET DECIMAL PØINT LØCATØR              EAD 215
          B     S5090                                                EAD 216
S510      MVI   SIGN.1,X-D0-  SET SIGN MINUS                         EAD 217
          B     S5090                                                EAD 218
LØG       NØP   LØGICAL       BRANCH ØNLY IF DECIMAL PØINT PRECEDES  EAD 219
          B     ERRØR                                                EAD 220
S509      MVI   SIGN.1,X-C0-  SET SIGN PLUS                          EAD 221
S5090     CØL72 H,ERRØR                                              EAD 222
          CØMP  ZERØ,NL,NUM                                          EAD 223
          CØMP  DECIMAL,E,S5080                                      EAD 224
          CØMP  F,NL,LØG                                             EAD 225
          B     ERRØR                                                EAD 226
S503      MVI   SIGN.1,X-C0-  NUMERIC, SET SIGN PLUS                 EAD 227
NUM       LR    RT,RC         PRØCESS NUMERIC FIELD                  EAD 228
          LA    RW,910,RT*                                           EAD 229
          ST    RW,D8                                                EAD 230
NEXTC     CØL72 H,S501        EXAMINE NEXT CHARACTER IN NUMERIC FIELD EAD 231
          CØMP  ZERØ,NL,S513                                         EAD 232
          CØMP  D,NL,S504                                            EAD 233
          CØMP  DECIMAL,E,S502                                       EAD 234
          CØMP  MINUS,E,S521                                         EAD 235
          CØMP  PLUS026,E,S521                                       EAD 236
          CØMP  PLUS029,E,S521                                       EAD 237
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         COMP   BLANK,E,S501                                                EAD  238
         COMP   LP026,E,LEFTP                                               EAD  239
         COMP   LP029,E,LEFTP                                               EAD  240
         COMP   RP026,E,RIGHTP                                              EAD  241
         COMP   RP029,E,RIGHTP                                              EAD  242
         COMP   COMMA,NE,ERROR                                              EAD  243
S501     CHECK  RS,NZ,FLOAT      CHECK FOR FLOATING POINT                   EAD  244
INTGER   CHECK  R5,Z,INTGER1     CHECK FOR INCREMENTING                     EAD  245
         BP     ERROR            UNBALANCED PARENTHESES                     EAD  246
         SR     R5,R5            ZERO OUT INCREMENTING FLAG                 EAD  247
         B      INCREM                                                      EAD  248
INTGER1  BAL    14,LA000C        CONVERT BCD TO BINARY INTEGER              EAD  249
         CLI    LENGTH.1,3       CHECK LENGTH OF VARIABLE                   EAD  250
         BH     INT4                                                        EAD  251
         MVI    STOREI,X-40-     CONVERT STORE INSTRUCTION TO -STH-         EAD  252
STOREI   ST     RW,010,RA*       STORE INTEGER VALUE                        EAD  253
         AR     RA,RI            INCREMENT STORAGE ADDRESS                  EAD  254
DASHI    B      NEWFIELD                                                    EAD  255
DASHI1   NOP    DASHI2                                                      EAD  256
         LH     RS,NMAX                                                     EAD  257
         SH     RS,NMIN                                                     EAD  258
         A      RS,ONE                                                      EAD  259
         MVI    DASHI1.1,X-F0-                                              EAD  260
DASHI2   BCT    RS,STOREI                                                   EAD  261
         MVI    DASHI1.1,X-00-                                              EAD  262
         B      DASHDONE                                                    EAD  263
LEFTP1   S      RC,ONE                                                      EAD  264
LEFTP    CHECK  RS,NZ,FLOATL     CHECK FOR FLOATING POINT                   EAD  265
         CHECK  R5,Z,FIRSTL      IS THIS THE FIRST LEFT PARENTHESIS         EAD  266
         BP     ERROR            UNBALANCED PARENTHESES                     EAD  267
         LA     R5,1             SET INCREMENTING FLAG                      EAD  268
INCREM   BAL    14,LA000C        CONVERT BCD TO BINARY INTEGER              EAD  269
         LR     14,RW            PICK UP NSTOP                              EAD  270
         SR     14,R7            SUBTRACT NSTART                            EAD  271
         SRDA   14,32            RIGHT ADJUST FOR DIVISION                  EAD  272
         DR     14,R11           DIVIDE BY NINCRM                           EAD  273
         CHECK  R5,P,MULT        CHECK FOR MULTIPLE INCREMENTING            EAD  274
         LA     15,110,15*       STANDARD INCREMENTING, SO STORE NSTOP ALSO EAD  275
MULT     CLI    LENGTH.1,3       CHECK LENGTH OF VARIABLE                   EAD  276
         BH     INC4                                                        EAD  277
         MVI    LPINC,X-40-      CONVERT STORE INSTRUCTION TO -STH-         EAD  278
LPINC    ST     R7,010,RA*       STORE INTEGER VALUE                        EAD  279
         AR     R7,R11           INCREMENT INTEGER VALUE                    EAD  280
         AR     RA,RI            INCREMENT STORAGE ADDRESS                  EAD  281
         BCT    15,LPINC                                                    EAD  282
         CHECK  R5,P,QQQ         CHECK FOR MULTIPLE INCREMENTING            EAD  283
         COL72  H,NEXTCARD                                                  EAD  284
         B      NEWFIELD                                                    EAD  285
INC4     MVI    LPINC,X-50-      CONVERT STORE INSTRUCTION TO -ST-          EAD  286
         B      LPINC                                                       EAD  287
FIRSTL   LA     R5,1             SET INCREMENTING FLAG                      EAD  288
         BAL    14,LA000C        CONVERT BCD TO BINARY INTEGER              EAD  289
QQQ      LR     R7,RW            PICK UP NSTART                             EAD  290
         COL72  H,ERROR                                                     EAD  291
         B      NEWFIELD                                                    EAD  292
RIGHTP1  S      RC,ONE                                                      EAD  293
RIGHTP   CHECK  RS,NZ,FLOATR     CHECK FOR FLOATING POINT                   EAD  294
         CHECK  R5,NP,ERROR      ERROR IF NO LEFT PARENTHESIS HAS PRECEDED  EAD  295
         LCR    R5,R5            CHANGE SIGN OF INCREMENTING FLAG           EAD  296
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         BAL   14,LA000C        CØNVERT BCD TØ BINARY INTEGER                   EAD  297
         LR    R11,RW           PICK UP NINCRM                                  EAD  298
         CØL72 H,ERRØR                                                          EAD  299
         B     NEWFIELD                                                         EAD  300
S519     CHECK RS,NZ,NEXTC      BRANCH IF DECIMAL PØINT HAS BEEN SEEN           EAD  301
         C     RC,D8          IF MØRE THAN NINE DIGITS TØ LEFT ØF               EAD  302
         BH    GR9              DECIMAL PØINT, BRANCH ØUT                       EAD  303
         B     NEXTC                                                            EAD  304
S504     CØMP  E,H,ERRØR        EXPØNENT FIELD                                  EAD  305
         CHECK R8,NZ,ERRØR      ERRØR IF MØRE THAN ØNE EXPØNENT FIELD           EAD  306
         CLI   1)RC*,BLANK      CHECK FØR BLANK AFTER D ØR E                    EAD  307
         BNE   S5041                                                            EAD  308
         MVI   1)RC*,PLUS026    INSERT PLUS SIGN ØVER BLANK                     EAD  309
S5041    LR    R8,RC            PICK UP LØCATIØN ØF EXPØNENT                    EAD  310
         CHECK RS,NZ,NEXTC      SEE IF DECIMAL PØINT HAS BEEN FØUND             EAD  311
         LR    RS,RC            IF NØT, ASSUME IT IS TØ LEFT ØF EXPØNENT        EAD  312
         B     NEXTC            EXAMINE NEXT CHARACTER                          EAD  313
INT4     MVI   STØREI,X-50-     CØNVERT STØRE INSTRUCTIØN TØ -ST-               EAD  314
         B     STØREI                                                           EAD  315
S521     CHECK R8,NZ,NEXTC      BRANCH IF E ØR D HAS BEEN SEEN                  EAD  316
         B     S5041                                                            EAD  317
S502     CHECK RS,NZ,ERRØR      ERRØR IF MØRE THAN ØNE DECIMAL PØINT            EAD  318
         LR    RS,RC            SET DECIMAL PØINT LØCATØR                       EAD  319
         B     NEXTC                                                            EAD  320
GR9      CØL72 H,INTG           MØRE THAN NINE DIGITS TØ LEFT ØF DECIMAL        EAD  321
         CØMP  BLANK,E,INTG                                                     EAD  322
         CØMP  LP026,E,LEFTP1                                                   EAD  323
         CØMP  LP029,E,LEFTP1                                                   EAD  324
         CØMP  RP026,E,RIGHTP1                                                  EAD  325
         CØMP  RP029,E,RIGHTP1                                                  EAD  326
         CØMP  CØMMA,NE,ERRØR                                                   EAD  327
INTG     S     RC,ØNE                                                           EAD  328
         B     INTGER                                                           EAD  329
         EJECT                                                                  EAD  330
*        THE PRØCESSING ØF FLØATING PØINT DATA                                  EAD  331
         SPACE 2                                                                EAD  332
*        ADDRESS ØF FIRST NUMERICAL CHARACTER IN RT                             EAD  333
*        ADDRESS ØF NEXT BYTE AFTER LAST CHARACTER IN RC                        EAD  334
*        ADDRESS ØF DECIMAL PØINT IN RS                                         EAD  335
*        ADDRESS ØF EXPØNENT IN R8                                              EAD  336
*        IF NØ EXPØNENT, R8 IS SET TØ ZERØ                                      EAD  337
*        FLØATING PØINT ANSWER IN REGISTER 2                                    EAD  338
FLØATL   CHECK R5,Z,FLØATLP     IS THIS THE FIRST LEFT PARENTHESIS              EAD  339
         BP    ERRØR            UNBALANCED PARENTHESES                          EAD  340
MULTINC  LA    R5,1             SET INCREMENTING FLAG                           EAD  341
         B     FLØATN-4                                                         EAD  342
FLØATLP  MVI   STØREF.1,X-F0-                                                   EAD  343
         LA    R5,1             SET INCREMENTING FLAG                           EAD  344
         B     FLØATN                                                           EAD  345
FLØATR   CHECK R5,NP,ERRØR      ERRØR IF NØ LEFT PARENTHESIS HAS PRECEDED       EAD  346
         LCR   R5,R5            CHANGE SIGN ØF INCREMENTING FLAG                EAD  347
         MVI   STØREF.5,X-F0-                                                   EAD  348
         B     FLØATN                                                           EAD  349
FLØAT    CHECK R5,Z,FLØATN      CHECK FØR INCREMENTING                          EAD  350
         BP    ERRØR            UNBALANCED PARENTHESES                          EAD  351
         SR    R5,R5            ZERØ ØUT INCREMENTING FLAG                      EAD  352
         MVI   STØREF.9,X-F0-                                                   EAD  353
FLØATN   ST    RC,CØLNØ         SAVE CARD CØLUMN CØUNTER                        EAD  354
         SDR   0,0                                                              EAD  355
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         CHECK R8,NZ,EXPØN    CHECK FØR EXPØNENT IN FIELD                EAD  356
GØØN     CR    RS,RT                                                     EAD  357
         BL    LTØNE                                                     EAD  358
         ST    RC,CØL                                                    EAD  359
         LR    RC,RS                                                     EAD  360
         BAL   14,LA000C      CØNVERT TØ BINARY INTEGER                  EAD  361
         BAL   14,LA000F      CØNVERT TØ FLØATING PØINT                  EAD  362
         L     RC,CØL                                                    EAD  363
LTØNE    LR    RW,RC                                                     EAD  364
         LA    RT,1)0,RS*                                                EAD  365
         LDR   2,0                                                       EAD  366
         SR    RW,RT                                                     EAD  367
         BNP   EXPF                                                      EAD  368
         C     RW,NINE                                                   EAD  369
         BH    MØRE                                                      EAD  370
FIRST9   LR    RS,RW                                                     EAD  371
         BAL   14,LA000C      CØNVERT TØ BINARY INTEGER                  EAD  372
         BAL   14,LA000F      CØNVERT TØ FLØATING PØINT                  EAD  373
         SLA   RS,3                                                      EAD  374
         MD    0,TENT)RS*                                                EAD  375
         ADR   2,0                                                       EAD  376
MR1      NØP   MØRE1                                                     EAD  377
MR2      NØP   MØRE2                                                     EAD  378
EXPF     NØP   EXPN                                                      EAD  379
         B     STØREF                                                    EAD  380
EXPØN    LR    RC,R8                                                     EAD  381
         IC    RW,0)0,R8*                                                EAD  382
         STC   RW,NUMWD                                                  EAD  383
         MVI   EXPF.1,X-F0-                                              EAD  384
         B     GØØN                                                      EAD  385
MØRE     MVI   MR1.1,X-F0-                                               EAD  386
         ST    RC,CØL                                                    EAD  387
         LA    RC,9)0,RT*                                                EAD  388
         IC    RW,0)0,RC*                                                EAD  389
         STC   RW,NUMWD.1                                                EAD  390
         L     RW,NINE                                                   EAD  391
         B     FIRST9                                                    EAD  392
MØRE1    MVI   MR1.1,X-00-                                               EAD  393
         IC    RW,NUMWD.1                                                EAD  394
         STC   RW,0)0,RC*                                                EAD  395
         LR    RT,RC                                                     EAD  396
         L     RC,CØL                                                    EAD  397
         MVI   MR2.1,X-F0-                                               EAD  398
         LR    RW,RC                                                     EAD  399
         SR    RW,RT                                                     EAD  400
         C     RW,NINE                                                   EAD  401
         BNH   *.12                                                      EAD  402
         L     RW,NINE                                                   EAD  403
         LA    RC,9)0,RT*                                                EAD  404
         A     RW,NINE                                                   EAD  405
         B     FIRST9                                                    EAD  406
MØRE2    MVI   MR2.1,X-00-                                               EAD  407
         L     RC,CØL                                                    EAD  408
         B     EXPF                                                      EAD  409
REAL4    MVI   STØREFL,X-70- CØNVERT STØRE INSTRUCTIØN TØ -STE-          EAD  410
         B     STØREFL                                                   EAD  411
NEXTE    CØL72 H,ERRØR                                                   EAD  412
         B     NXTE                                                      EAD  413
PØS      MVI   SIGN.1,X-C0-                                              EAD  414
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NEXTN    COL72 H,ERROR                                           EAD  415
         B     NEXP                                              EAD  416
NEG      MVI   SIGN,1,X-D0-                                      EAD  417
         B     NEXTN                                             EAD  418
EXPN     LR    RT,R8                                             EAD  419
         MVI   SIGN,1,X-C0-  ASSUME EXPONENT SIGN IS POSITIVE    EAD  420
         MVI   EXPF,1,X-00-                                      EAD  421
         LR    RC,RT                                             EAD  422
         IC    RW,NUMWD                                          EAD  423
         STC   RW,0(0,RC)                                        EAD  424
         COMP  D,E,NEXTE                                         EAD  425
         COMP  E,E,NEXTE                                         EAD  426
NXTE     COMP  ZERO,NL,NEXP                                      EAD  427
         COMP  MINUS,E,NEG                                       EAD  428
         COMP  PLUS026,E,POS                                     EAD  429
         COMP  PLUS029,E,POS                                     EAD  430
         B     ERROR                                             EAD  431
NEXP     LR    RT,RC                                             EAD  432
         L     RC,COLNO      RESTORE CARD COLUMN COUNTER         EAD  433
         BAL   14,LA000C     CONVERT EXPONENT TO A BINARY INTEGER EAD 434
         ST    RW,D8                                             EAD  435
         ST    RA,COL                                            EAD  436
         LA    1,ARGLIST                                         EAD  437
         STD   2,DOUBLE                                          EAD  438
         L     15,VFDXPI                                         EAD  439
         BALR  14,15                                             EAD  440
         LD    2,DOUBLE                                          EAD  441
         L     RA,COL                                            EAD  442
         MDR   2,0                                               EAD  443
STOREF   NOP   FLTLP                                             EAD  444
         NOP   FLTRP                                             EAD  445
         NOP   FINCREM                                           EAD  446
         CLI   LENGTH,1,6    CHECK LENGTH OF VARIABLE            EAD  447
         BL    REAL4                                             EAD  448
         MVI   STOREFL,X-60- CONVERT STORE INSTRUCTION TO -STD-  EAD  449
STOREFL  STD   2,0(0,RA)     STORE FLOATING POINT VALUE          EAD  450
         AR    RA,RI         INCREMENT STORAGE ADDRESS           EAD  451
DASHF    B     NEWFIELD                                          EAD  452
DASHF1   NOP   DASHF2                                            EAD  453
         LH    RS,NMAX                                           EAD  454
         SH    RS,NMIN                                           EAD  455
         A     RS,ONE                                            EAD  456
         MVI   DASHF1,1,X-F0-                                    EAD  457
DASHF2   BCT   RS,STOREFL                                        EAD  458
         MVI   DASHF1,1,X-00-                                    EAD  459
         B     DASHDONE                                          EAD  460
FLTLP    MVI   STOREF,1,X-00-                                    EAD  461
         LDR   6,2           PICK UP FSTART                      EAD  462
         COL72 H,ERROR                                           EAD  463
         B     NEWFIELD                                          EAD  464
FLTRP    MVI   STOREF,5,X-00-                                    EAD  465
         LDR   4,2           PICK UP FINCRM                      EAD  466
         COL72 H,ERROR                                           EAD  467
         B     NEWFIELD                                          EAD  468
FINCREM  MVI   STOREF,9,X-00-                                    EAD  469
         LDR   0,2           PICK UP FSTOP                       EAD  470
         SDR   0,6           SUBTRACT FSTART                     EAD  471
         DDR   0,4           DIVIDE BY FINCRM                    EAD  472
         AD    0,TENT,96     ADJUST FOR ROUND-OFF                EAD  473
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         AW     0,CFLØAT         CØNVERT TØ AN INTEGER                    EAD  474
         STD    0,D8                                                      EAD  475
         L      15,D8,4                                                   EAD  476
         CHECK  R5,P,MULTF       CHECK FØR MULTIPLE INCREMENTING          EAD  477
         LA     15,1)0,15*       STANDARD INCREMENTING, SØ STØRE FSTØP ALSØ EAD  478
MULTF    CLI    LENGTH,1,6       CHECK LENGTH ØF VARIABLE                 EAD  479
         BL     RINC4                                                     EAD  480
         MVI    LPINCF,X-60-     CØNVERT STØRE INSTRUCTIØN TØ -STD-       EAD  481
LPINCF   STD    6,0)0,RA*        STØRE FLØATING PØINT VALUE               EAD  482
         ADR    6,4              INCREMENT FLØATING PØINT VALUE           EAD  483
         AR     RA,RI            INCREMENT STØRAGE ADDRESS                EAD  484
         BCT    15,LPINCF                                                 EAD  485
         CHECK  R5,P,FLTLP,4     CHECK FØR MULTIPLE INCREMENTING          EAD  486
         CØL72  H,NEXTCARD                                                EAD  487
         B      NEWFIELD                                                  EAD  488
RINC4    MVI    LPINCF,X-70-     CØNVERT STØRE INSTRUCTIØN TØ -STE-       EAD  489
         B      LPINCF                                                    EAD  490
         EJECT                                                            EAD  491
*        THE PRØCESSING ØF A-TYPE CARDS                                   EAD  492
         SPACE  2                                                         EAD  493
ACARD    MVI    NFLAG,1,X-F0-    SET A-CARD FLAGS                         EAD  494
         MVI    NFLAG1,1,X-F0-                                            EAD  495
         MVI    NFLAG2,1,X-F0-                                            EAD  496
         MVI    NFLAG3,1,X-F0-                                            EAD  497
         LA     R8,1                                                      EAD  498
S321     BXLE   RC,R8,*,8                                                 EAD  499
         B      ERRØR                                                     EAD  500
         CØMP   BLANK,E,S321                                              EAD  501
         CØMP   A,NL,LETTER                                               EAD  502
         CØMP   DØLLAR,E,LETTER                                           EAD  503
         B      ERRØR                                                     EAD  504
ACARD1   LA     R8,1             LØØK FØR FIELD LENGTH                    EAD  505
         SR     RW,RW                                                     EAD  506
S322     BXLE   RC,R8,*,8                                                 EAD  507
         B      ERRØR                                                     EAD  508
         CØMP   BLANK,E,S322                                              EAD  509
         CØMP   ZERØ,NL,S323                                              EAD  510
         CØMP   LP026,E,SUBSCRPT                                          EAD  511
         CØMP   LP029,E,SUBSCRPT                                          EAD  512
         B      ERRØR                                                     EAD  513
S323     LR     RT,RC            PRØCESS FIELD LENGTH                     EAD  514
S325     BXLE   RC,R8,*,8                                                 EAD  515
         B      S326                                                      EAD  516
         CØMP   BLANK,E,S326                                              EAD  517
         CØMP   ZERØ,NL,S325                                              EAD  518
         B      ERRØR                                                     EAD  519
S326     MVI    SIGN,1,X-C0-     INSERT PLUS SIGN                         EAD  520
         BAL    14,LA000C        CØNVERT BCD TØ BINARY INTEGER            EAD  521
         STH    RW,NUMWD         SAVE AS NUMBER ØF WØRDS                  EAD  522
         MH     RW,LENGTH        MULTIPLY BY LENGTH ØF VARIABLE           EAD  523
         C      RW,C72           CØMPARE RESULT WITH 72                   EAD  524
         BH     ERRØR            ERRØR IF GREATER THAN 72                 EAD  525
S327     BXLE   RC,R8,*,8                                                 EAD  526
         B      S329                                                      EAD  527
         CØMP   BLANK,E,S327                                              EAD  528
         CØMP   ZERØ,NL,S323                                              EAD  529
         B      ERRØR                                                     EAD  530
S329     CHECK  RW,Z,ERRØR                                                EAD  531
         B      READCARD                                                  EAD  532
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ACARD2   LH    RW,LENGTH      STØRE THE ALPHAMERIC DATA                    EAD  533
         LR    RT,RW                                                       EAD  534
         S     RT,ØNE                                                      EAD  535
         STC   RT,MVA+1                                                    EAD  536
         LH    RT,NUMWD                                                    EAD  537
MVA      MVC   0(0,RA),0(RC)                                               EAD  538
         AR    RC,RW                                                       EAD  539
         AR    RA,RI                                                       EAD  540
         BCT   RT,MVA                                                      EAD  541
         MVI   NFLAG,1,X-00- RESET A-CARD FLAGS                            EAD  542
         MVI   NFLAG1,1,X-00-                                              EAD  543
         MVI   NFLAG2,1,X-00-                                              EAD  544
         MVI   NFLAG3,1,X-00-                                              EAD  545
         B     READCARD                                                    EAD  546
         SPACE 5                                                           EAD  547
*        THE PRØCESSING ØF H-TYPE CARDS                                    EAD  548
         SPACE 2                                                           EAD  549
HCARD    MVC   HEADING,1(79,RC) MØVE TØ ØUTPUT FØRMAT FØR HEDING           EAD  550
         B     READCARD                                                    EAD  551
         EJECT                                                             EAD  552
*        THE PRØCESSING ØF VARIABLE NAME FIELDS                            EAD  553
         SPACE 2                                                           EAD  554
LETTER   MVI   LPAREN,1,X-00-                                              EAD  555
         LA    R8,1                                                        EAD  556
         MVI   EITHER+1,X-F0-                                              EAD  557
         LR    RW,RC                                                       EAD  558
         A     RW,C7                                                       EAD  559
         MVI   S420+1,X-00-                                                EAD  560
         LR    RT,RC                                                       EAD  561
MØREL    BXLE  RC,R8,*+8      CHECK FØR CØLUMN 72                          EAD  562
         B     S420                                                        EAD  563
         CR    RC,RW          SEE IF EIGHT CHARACTERS HAVE BEEN SEEN       EAD  564
         BH    S405                                                        EAD  565
PASS1    CØMP  BLANK,E,S420  LØØK FØR A FIELD TERMINATØR                   EAD  566
         CØMP  EQ026,E,S420                                                EAD  567
         CØMP  EQ029,E,S420                                                EAD  568
         CØMP  LP026,E,S419                                                EAD  569
         CØMP  LP029,E,S419                                                EAD  570
EITHER   B     MØREL                                                       EAD  571
EXTRA    BXLE  RC,R8,PASS1    CHECK FØR CØLUMN 72                          EAD  572
         B     S420                                                        EAD  573
S405     MVI   EITHER+1,X-00-  EIGHT CHARACTERS HAVE BEEN SEEN             EAD  574
         MVI   S420+1,X-F0-                                                EAD  575
         MVI   MVC1+1,7                                                    EAD  576
         B     PASS1                                                       EAD  577
S419     MVI   LPAREN+1,X-F0-  LEFT PARENTHESIS TERMINATES NAME            EAD  578
S420     NØP   S4200                                                       EAD  579
         LR    RW,RC                                                       EAD  580
         SR    RW,RT                                                       EAD  581
         S     RW,ØNE                                                      EAD  582
         STC   RW,MVC1+1                                                   EAD  583
S4200    MVC   D8(8),BLANKS                                                EAD  584
MVC1     MVC   D8(0),0(RT)                                                 EAD  585
LA000L   LH    RT,NUMTAB      LØØK FØR VARIABLE NAME IN TABLE              EAD  586
         L     RW,STABLE                                                   EAD  587
LP2      CLC   0(8,RW),D8                                                  EAD  588
         BE    FØUND                                                       EAD  589
         LA    RW,28(0,RW)                                                 EAD  590
         BCT   RT,LP2                                                      EAD  591
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         B        ERRØR2
FØUND    L        RT,8)0,RW*      NAME HAS BEEN FØUND
         ST       RT,NADD
         LH       RT,12)0,RW*
         STH      RT,LENGTH
         LH       RT,14)0,RW*
         STH      RT,NUMSCR
         MVC      NS)12*,16)RW*
         SR       RI,RI
         CHECK    RT,Z,NØSUBS     SEE IF VARIABLE IS AN ARRAY
         LH       RI,LENGTH
         SLA      RT,1
         ST       RT,NUMSCR2
NØSUBS   L        RA,NADD         PICK UP STØRAGE ADDRESS
LPAREN   NØP      S423            BRANCH ØNLY IF LEFT PARENTHESIS WAS SEEN
NFLAG1   NØP      ACARD1
         B        NEWFIELD
S423     CHECK    RT,Z,ERRØR      ERRØR IF VARIABLE IS NØT AN ARRAY
         EJECT
*        THE PRØCESSING ØF SUBSCRIPT FIELDS
         SPACE 2
SUBSCRPT MVI      DASHDNE,1,X-F0-
         B        DASHDØNE
SUBSC    MVI      DØNE1,1,X-D0-
         MVI      SIGN,1,X-C0-
         MVI      DNE,1,X-F0-
         SR       RS,RS
SUBLØØP  CØL72    H,ERRØR
         CØMP     BLANK,E,SUBLØØP
         CØMP     ZERØ,L,ERRØR
         LR       RT,RC
NEXTNS   CØL72    H,ERRØR
         CØMP     ZERØ,NL,NEXTNS
         CØMP     CØMMA,E,ENDSUB
         CØMP     RP026,E,ESUBS
         CØMP     RP029,E,ESUBS
         CØMP     BLANK,E,SKIPS
         CØMP     MINUS,NE,ERRØR
S1048    NØP      ERRØR
         MVI      S1048,1,X-F0-
         MVI      ND1,1,X-F0-
         B        ENDSUB
ESUBS    MVI      DNE,1,X-00-
ENDSUB   NØP      S1046
         LA       RS,2)0,RS*
         C        RS,NUMSCR2
         BH       ERRØR
         BAL      14,LA000C
         STH      RW,SUB-2)RS*
ND1      NØP      S1049
BLNK     NØP      LCØM
DNE      NØP      SUBLØØP
PAR      SRA      RS,1
         LR       RW,RS
ND2      NØP      S1047
ØUTSUB   CØL72    H,SUBDØNE
         CØMP     BLANK,E,SUBDØNE
         CØMP     EQ026,E,SUBDØNE
         CØMP     EQ029,E,SUBDØNE
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         CLI   0(RC),ZERO                                    EAD 651
DONE1    BNH   ERROR                                         EAD 652
         NI    0(RC),X'0F'                                   EAD 653
         SR    RW,RW                                         EAD 654
         IC    RW,0(0,RC)                                    EAD 655
         CH    RW,NUMSCR                                     EAD 656
         BH    ERROR                                         EAD 657
ND3      MVI   DONE1+1,X'F0'                                 EAD 658
         B     OUTSUB                                        EAD 659
SKIPS    MVI   BLNK+1,X'F0'                                  EAD 660
         B     ENDSUB                                        EAD 661
LCOM     COL72 H,ERROR                                       EAD 662
         MVI   BLNK+1,X'00'                                  EAD 663
         COMP  BLANK,E,LCOM                                  EAD 664
         COMP  COMMA,E,SUBLOOP                               EAD 665
         COMP  RP026,E,PAR                                   EAD 666
         COMP  RP029,E,PAR                                   EAD 667
         COMP  MINUS,E,S1045                                 EAD 668
         B     ERROR                                         EAD 669
SUBDONE  LH    RT,SUB                                        EAD 670
         S     RT,ONE                                        EAD 671
         LH    RI,LENGTH                                     EAD 672
         S     RS,ONE                                        EAD 673
         BZ    ONESUB                                        EAD 674
         STH   RW,NUMWD                                      EAD 675
         SR    RW,RW                                         EAD 676
SLOOP    LH    R8,SUB+2(RW)                                  EAD 677
         S     R8,ONE                                        EAD 678
         MH    R8,NS(RW)                                     EAD 679
         AR    RT,R8                                         EAD 680
         LA    RW,2(0,RW)                                    EAD 681
         BCT   RS,SLOOP                                      EAD 682
         LH    RW,NUMWD                                      EAD 683
ONESUB   L     RA,NADD                                       EAD 684
         MH    RT,LENGTH                                     EAD 685
         AR    RA,RT                                         EAD 686
         S     RW,ONE                                        EAD 687
         BZ    NFLAG2                                        EAD 688
         SLA   RW,1                                          EAD 689
         S     RW,TWO                                        EAD 690
         MH    RI,NS(RW)                                     EAD 691
NFLAG2   NOP   ACARD1                                        EAD 692
         COL72 H,NEXTCARD                                    EAD 693
         B     NEWFIELD                                      EAD 694
S1045    EX    0,S1048                                       EAD 695
         MVI   S1048+1,X'F0'                                 EAD 696
S1049    STH   RW,NMIN                                       EAD 697
         LR    RW,RS                                         EAD 698
         SRA   RW,1                                          EAD 699
         STH   RW,NUMWD                                      EAD 700
         MVI   ND1+1,X'00'                                   EAD 701
         MVI   ENDSUB+1,X'F0'                                EAD 702
         B     SUBLOOP                                       EAD 703
S1046    MVI   ENDSUB+1,X'00'                                EAD 704
NFLAG3   NOP   ERROR                                         EAD 705
         MVI   ND2+1,X'F0'                                   EAD 706
         BAL   14,LA000C                                     EAD 707
         STH   RW,NMAX                                       EAD 708
         B     BLNK                                          EAD 709
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S1047    MVI   S1048.1,X-00-                                          EAD  710
         MVI   ND2.1,X-00-                                            EAD  711
         LH    RW,NUMWD                                               EAD  712
         MVI   DASHDNE.1,X-00-                                        EAD  713
         MVI   DASHA.1,X-00-  SET DASH SWITCHES                       EAD  714
         MVI   DASHL.1,X-00                                           EAD  715
         MVI   DASHH.1,X-00-                                          EAD  716
         MVI   DASHF.1,X-00-                                          EAD  717
         MVI   DASHI.1,X-00-                                          EAD  718
         B     ND3                                                    EAD  719
DASHDØNE MVI   DASHA.1,X-F0-  RESET DASH SWITCHES                     EAD  720
         MVI   DASHL.1,X-F0-                                          EAD  721
         MVI   DASHH.1,X-F0-                                          EAD  722
         MVI   DASHF.1,X-F0-                                          EAD  723
         MVI   DASHI.1,X-F0-                                          EAD  724
DASHDNE  NØP   SUBSC                                                  EAD  725
         B     NEWFIELD                                               EAD  726
         EJECT                                                        EAD  727
*        THE PRØCESSING ØF HEXADECIMAL DATA                           EAD  728
         SPACE 2                                                      EAD  729
HEXCARD  CØL72 H,READCARD                                             EAD  730
         CØMP  BLANK,E,HEXCARD                                        EAD  731
         LR    RT,RC                                                  EAD  732
STAY     CØMP  ZERØ,NL,NUMB                                           EAD  733
         CØMP  F,H,ERRØR                                              EAD  734
         CØMP  A,L,ERRØR                                              EAD  735
         IC    RW,0(0,RC*                                             EAD  736
         AH    RW,CONV        CØNVERT -C1- - -C6- TØ -FA- - -FF-      EAD  737
         STC   RW,0(0,RC*                                             EAD  738
NUMB     CØL72 H,STØREH                                               EAD  739
         CØMP  BLANK,NE,STAY                                          EAD  740
STØREH   LR    RW,RC                                                  EAD  741
         SR    RW,RT                                                  EAD  742
         LH    R8,LENGTH                                              EAD  743
         SLA   R8,1                                                   EAD  744
         CR    RW,R8                                                  EAD  745
         BH    ERRØR                                                  EAD  746
         SDR   0,0                                                    EAD  747
         STD   0,D8                                                   EAD  748
         STD   0,DØUBLE                                               EAD  749
         S     RW,ØNE                                                 EAD  750
         STC   RW,LENG.1                                              EAD  751
         NI    PK.1,X-F0-                                             EAD  752
LENG     ØI    PK.1,X-00-                                             EAD  753
PK       PACK  D8-1(9*,0(0,RT* CØNVERT BCD TØ HEXADECIMAL             EAD  754
         LM    RT,RW,D8                                               EAD  755
         SRDL  RT,4           SHIFT ØUT SIGN                          EAD  756
         STM   RT,RW,D8                                               EAD  757
         IC    RW,D8-1        INSERT FIRST HALF-BYTE                  EAD  758
         SLL   RW,4                                                   EAD  759
         STC   RW,LMØST.1                                             EAD  760
LMØST    ØI    D8,X-00-                                               EAD  761
         L     RS,D8.4                                                EAD  762
         LD    4,D8                                                   EAD  763
         CLI   LENGTH.1,6     CHECK LENGTH ØF VARIABLE                EAD  764
         BL    TIMES4                                                 EAD  765
         MVI   STØRHEX,X-60-  CØNVERT STØRE INSTRUCTIØN TØ -STD-      EAD  766
STØRHEX  STD   4,0(0,RA*      STØRE HEXADECIMAL DATA                  EAD  767
         AR    RA,RI          INCREMENT STØRAGE ADDRESS               EAD  768
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DASHH     B      NEXTH                                                   EAD 769
DASHH1    NØP    DASHH2                                                  EAD 770
          LH     RW,NMAX                                                 EAD 771
          SH     RW,NMIN                                                 EAD 772
          A      RW,ØNE                                                  EAD 773
          MVI    DASHH1.1,X-FO-                                          EAD 774
DASHH2    BCT    RW,STØRHEX                                              EAD 775
          MVI    DASHH1.1,X-00-                                          EAD 776
          MVI    DASHA.1,X-FO- RESET DASH SWITCHES                       EAD 777
          MVI    DASHL.1,X-FO-                                           EAD 778
          MVI    DASHH.1,X-FO-                                           EAD 779
          MVI    DASHF.1,X-FO-                                           EAD 780
          MVI    DASHI.1,X-FO-                                           EAD 781
NEXTH     CR     RC,RCMAX                                                EAD 782
          BH     READCARD                                                EAD 783
          B      HEXCARD                                                 EAD 784
TIMES4    MVI    STØRHEX,X-50- CØNVERT STØRE INSTRUCTIØN TØ -STE-        EAD 785
          B      STØRHEX                                                 EAD 786
          EJECT                                                          EAD 787
*         THE PRØCESSING ØF ALPHAMERIC DATA                              EAD 788
          SPACE 2                                                        EAD 789
ALPHA     LH     RS,LENGTH      PICK UP LENGTH ØF VARIABLE               EAD 790
          S      RS,ØNE                                                  EAD 791
          STC    RS,MVS.1                                                EAD 792
          STC    RS,MVS1.1                                               EAD 793
          CØL72  H,ERRØR                                                 EAD 794
          CØMP   BLANK,E,NØTHING                                         EAD 795
          LR     RT,RC                                                   EAD 796
          LR     RW,RC                                                   EAD 797
          AR     RW,RS                                                   EAD 798
MØREA     CØL72  H,STØREA                                                EAD 799
          CØMP   BLANK,E,STØREA                                          EAD 800
          CR     RC,RW                                                   EAD 801
          BH     ERRØR                                                   EAD 802
          B      MØREA                                                   EAD 803
STØREA    LR     RW,RC                                                   EAD 804
          SR     RW,RT                                                   EAD 805
          S      RW,ØNE                                                  EAD 806
          STC    RW,MVS1.1                                               EAD 807
MVS       MVC    010,RA*,BLANKS                                          EAD 808
MVS1      MVC    010,RA*,01RT* STØRE ALPHAMERIC DATA                     EAD 809
NEXTA     AR     RA,RI          INCREMENT STØRAGE ADDRESS                EAD 810
DASHA     B      NEWFIELD                                                EAD 811
DASHA1    NØP    DASHA2                                                  EAD 812
          LH     RS,NMAX                                                 EAD 813
          SH     RS,NMIN                                                 EAD 814
          A      RS,ØNE                                                  EAD 815
          MVI    DASHA1.1,X-FO-                                          EAD 816
DASHA2    BCT    RS,MVS                                                  EAD 817
          MVI    DASHA1.1,X-00-                                          EAD 818
          B      DASHDØNE                                                EAD 819
NØTHING   LA     RT,BLANKS                                               EAD 820
          B      MVS1                                                    EAD 821
          EJECT                                                          EAD 822
*         THE PRØCESSING ØF LØGICAL DATA                                 EAD 823
          SPACE 2                                                        EAD 824
LØGICAL   CØMP   T,E,TRUE       CHECK FØR -TRUE-                         EAD 825
          CØMP   F,E,LØGIC-2    CHECK FØR -FALSE-                        EAD 826
          CØMP   Y,E,TRUE       CHECK FØR -YES-                          EAD 827
```

```
         COMP  N,NE,ERROR     ERROR IF NOT -NO-                         EAD  828
         SR    RW,RW                                                    EAD  829
LOGIC    COL72 H,STOREL                                                 EAD  830
         COMP  BLANK,E,STOREL  LOOK FOR A FIELD TERMINATOR              EAD  831
         COMP  COMMA,E,STOREL                                           EAD  832
         B     LOGIC                                                    EAD  833
TRUE     LA    RW,1                                                     EAD  834
         B     LOGIC                                                    EAD  835
TIMES4L  MVI   STORLOG,X-50- CONVERT STORE INSTRUCTION TO -STE-         EAD  836
         B     STORLOG                                                  EAD  837
STOREL   CLI   LENGTH,1,3     CHECK LENGTH OF VARIABLE                  EAD  838
         BH    TIMES4L                                                  EAD  839
         MVI   STORLOG,X-42- CONVERT STORE INSTRUCTION TO -STC-         EAD  840
STORLOG  ST    RW,0)0,RA*     STORE LOGICAL VALUE                       EAD  841
         AR    RA,RI          INCREMENT STORAGE ADDRESS                 EAD  842
DASHL    B     NEWFIELD                                                 EAD  843
DASHL1   NOP   DASHL2                                                   EAD  844
         LH    RS,NMAX                                                  EAD  845
         SH    RS,NMIN                                                  EAD  846
         A     RS,ONE                                                   EAD  847
         MVI   DASHL1,.,X-F0-                                           EAD  848
DASHL2   BCT   RS,STORLOG                                               EAD  849
         MVI   DASHL1,1,X-00-                                           EAD  850
         B     DASHDONE                                                 EAD  851
         EJECT                                                          EAD  852
*        THIS ROUTINE CONVERTS BCD TO A SIGNED BINARY INTEGER           EAD  853
         SPACE 2                                                        EAD  854
*        ADDRESS OF FIRST NUMERICAL CHARACTER IN RT                     EAD  855
*        ADDRESS OF NEXT BYTE AFTER LAST CHARACTER IN RC                EAD  856
*        BINARY INTEGER ANSWER IN RW                                    EAD  857
*        TO INSERT MINUS SIGN, USE MVI   SIGN,1,X-D0-                   EAD  858
*        TO INSERT PLUS SIGN, USE MVI   SIGN,1,X-C0-                    EAD  859
LA000C   LR    RW,RC                                                    EAD  860
         SR    RW,RT                                                    EAD  861
         S     RW,ONE                                                   EAD  862
         STC   RW,LEN,1       INSERT FIELD LENGTH INTO PACK INSTRUCTION EAD  863
         NI    PACK,1,X-F0-                                             EAD  864
LEN      OI    PACK,1,X-00-                                             EAD  865
         LR    RW,RC          GET ADDRESS OF RIGHTMOST BYTE             EAD  866
         S     RW,ONE                                                   EAD  867
         NI    0)RW*,X-0F-    CLEAR ZONE FOR SIGN                       EAD  868
SIGN     OI    0)RW*,X-C0-    INSERT SIGN                               EAD  869
         SDR   0,0                                                      EAD  870
         STD   0,D8                                                     EAD  871
PACK     PACK  D8)8*,0)0,RT* PACK BCD                                   EAD  872
         CVB   RW,D8          CONVERT TO BINARY                         EAD  873
         BR    14             RETURN                                    EAD  874
         EJECT                                                          EAD  875
*        THIS ROUTINE CONVERTS A SIGNED BINARY INTEGER TO DOUBLE        EAD  876
*        PRECISION FLOATING POINT, USING THE SAME PROCEDURE AS FORTRAN  EAD  877
         SPACE 2                                                        EAD  878
*        BINARY INTEGER IN RW                                           EAD  879
*        FLOATING POINT ANSWER IN REGISTER 0                            EAD  880
LA000F   LD    0,CFLOAT                                                 EAD  881
         STD   0,D8                                                     EAD  882
         LTR   RW,RW                                                    EAD  883
         BM    *,16                                                     EAD  884
         ST    RW,D8,4                                                  EAD  885
         AD    0,D8                                                     EAD  886
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         B     *,14                                           EAD 887
         LPR   RW,RW                                          EAD 888
         ST    RW,D8,4                                        EAD 889
         SD    0,D8                                           EAD 890
         BCR   15,14                                          EAD 891
         EJECT                                                EAD 892
*        ERROR PROCESSING                                     EAD 893
         SPACE 2                                              EAD 894
ERROR1   LA    RW,FE1         ILLEGAL ENTRY TO SETUP OR READIN EAD 895
         ST    RW,FERROR                                      EAD 896
         B     ERR                                            EAD 897
ERROR2   MVC   NAME)8*,D8     NAME OF VARIABLE NOT FOUND IN TABLE EAD 898
         LA    RW,FE2                                         EAD 899
         ST    RW,FERROR                                      EAD 900
         B     ERR                                            EAD 901
ERROR    LA    RW,FE          ERROR IN FORMAT ON LAST CARD    EAD 902
         ST    RW,FERROR                                      EAD 903
ERR      L     15,VIBCOM      WRITE ERROR MESSAGE             EAD 904
         CNOP  0,4                                            EAD 905
         BAL   14,4)0,15*                                     EAD 906
         DC    F-6-                                           EAD 907
FERROR   DC    A)FE*                                          EAD 908
         BAL   14,16)0,15*                                    EAD 909
LEAVE    L     15,VEXIT       CALL EXIT                       EAD 910
         BALR  14,15                                          EAD 911
         EJECT                                                EAD 912
*        END-OF-DATA PROCESSING                               EAD 913
         SPACE 2                                              EAD 914
IEND     B     LEAVE          END-OF-JOB CARD                 EAD 915
         LA    15,4           SET UP NON-STANDARD RETURN      EAD 916
         B     RESTORE,2                                      EAD 917
RESTORE  SR    15,15          NORMAL RETURN TO CALLING PROGRAM EAD 918
         L     13,SAVE,4      RESTORE OLD SAVE AREA ADDRESS   EAD 919
         L     RW,ADINCOL1                                    EAD 920
         L     RT,INCOL1                                      EAD 921
         ST    RT,0)0,RW*                                     EAD 922
         LM    2,12,28)13*    RESTORE REGISTERS               EAD 923
         L     14,12)0,13*    PICK UP RETURN ADDRESS          EAD 924
         MVI   12)13*,X-FF-   INSERT RETURN FLAG              EAD 925
         BR    14             RETURN                          EAD 926
         DROP  RD             DON-T LET ASSEMBLER USE RD AS A BASE EAD 927
         EJECT                                                EAD 928
*        SUBROUTINE HEDING)NTAPE*                             EAD 929
*        THIS ROUTINE EJECTS A PAGE AND WRITES THE H-CARD     EAD 930
         SPACE 2                                              EAD 931
         USING *,12           INFORM ASSEMBLER OF BASE REGISTER EAD 932
HEDING   STM   12,14,12)13*   SAVE REGISTERS                  EAD 933
         LR    12,15          PICK UP BASE REGISTER           EAD 934
         ST    13,SAVE,4      SAVE ADDRESS OF OLD SAVE AREA   EAD 935
         L     13,0)0,1*      PICK UP ADDRESS OF TAPE NUMBER  EAD 936
         L     13,0)0,13*     PICK UP TAPE NUMBER             EAD 937
         ST    13,TAPENO      INSERT IT IN ARG LIST FOR IBCOM EAD 938
         LA    13,SAVE        PICK UP ADDRESS OF NEW SAVE AREA EAD 939
         L     15,VIBCOM                                      EAD 940
         CNOP  0,4                                            EAD 941
         BAL   14,4)0,15*     FLIP PAGE AND WRITE HEADING     EAD 942
TAPENO   DC    F-6-                                           EAD 943
         DC    A)FH*                                          EAD 944
         BAL   14,16)0,15*                                    EAD 945
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         L     13,SAVE,4          PICK UP ADDRESS ØF ØLD SAVE AREA
         LM    12,14,12)13*       RESTØRE REGISTERS
         MVI   12)13*,X-FF-       INSERT RETURN FLAG
         BR    14                 RETURN
         EJECT
*        SUBRØUTINE WHERE)TABLE*
*        THIS RØUTINE PICKS UP THE LØCATIØN ØF -TABLE- FØR -SETUP-
*         -WHERE- HAS BEEN MØDIFIED 5-2-68
*         TØ ACTIVATE MIDCØM. )W. SØHN*
*
         EXTRN MIBCØM
WHERE    BC    15,12)15*
         DC    X-7-
         DC    CL7-WHERE  -
*        SAVE PRØCEDURE
         STM   14,12,12)13*
         BALR  10,0
         USING *,10
         LR    2,13
         LA    13,SAVEREG
         ST    13,8)2*
         ST    2,4)13*
         BC    15,FIRST
SAVEREG  DS    18F
*        END SAVE PRØCEDURE
FIRST    NØP   NOTFIRST
         L     RT,0)1*
         ST    RT,TABLE
         ST    RT,STABLE
         MVI   FIRST,1,X-F0-
         LA    1,ARGULST
         L     15,ADCØN
         BALR  14,15
*        RETURN PRØCEDURE
NØTFIRST L     13,SAVEREG,4
         LM    2,12,28)13*
         L     14,12)13*
         MVI   12)13*,X-FF-
         BCR   15,14
*        END RETURN PRØCEDURE
ADCØN    DC    A)MIBCØM*
*        ARGUMENT LIST
ARGULST  DC    X-80-
         DC    AL3)**
*        END SUBRØUTINE WHERE
         EJECT
*        SUBRØUTINE SETUP)NAME,LENGTH,VARIABLE,DIMENSIØNS,...*
*        THIS RØUTINE CØNSTRUCTS THE TABLE ØF INPUT VARIABLES
*   WØRD                          CØNTENTS
*        ***************************************************
*        *                                                 *
*   1    *                                                 *
*        *            EBCDIC NAME ØF VARIABLE              *
*   2    *                                                 *
*        *                                                 *
*        ***************************************************
*        *                                                 *
*   3    *            CØRE ADDRESS ØF VARIABLE             *
*        *                                                 *
```

```
*        *****************************************************************  EAD 1005
*        *                                                               *  EAD 1006
*   4    *    LENGTH SPECIFICATION     *    NUMBER ØF SUBSCRIPTS         *  EAD 1007
*        *                                                               *  EAD 1008
*        *****************************************************************  EAD 1009
*        *                                                               *  EAD 1010
*   5    *           N1=NS)1*           *           N1*N2=NS)2*          *  EAD 1011
*        *                                                               *  EAD 1012
*        *****************************************************************  EAD 1013
*        *                                                               *  EAD 1014
*   6    *        N1*N2*N3=NS)3*        *       N1*N2*N3*N4=NS)4*        *  EAD 1015
*        *                                                               *  EAD 1016
*        *****************************************************************  EAD 1017
*        *                                                               *  EAD 1018
*   7    *    N1*N2*N3*N4*N5=NS)5*      *    N1*N2*N3*N4*N5*N6=NS)6*     *  EAD 1019
*        *                                                               *  EAD 1020
*        *****************************************************************  EAD 1021
         SPACE 2                                                            EAD 1022
         USING *,15                                                         EAD 1023
SETUP    STM   R6,R12,44)13* SAVE REGISTERS                                 EAD 1024
CHECK    NØP   GØ          BRANCH ARØUND IF NØT THE FIRST TIME THRØUGH      EAD 1025
         L     R11,STABLE                                                   EAD 1026
         CHECK R11,Z,ERRS  SEE IF -WHERE- HAS BEEN ENTERED                  EAD 1027
         MVI   CHECK,1,X-F0-                                                EAD 1028
GØ       L     R9,TABLE    PICK UP LØCATIØN FØR NEXT TABLE ENTRY            EAD 1029
         L     R11,0)0,1*  PICK UP ADDRESS ØF VARIABLE NAME                 EAD 1030
         MVC   0)8,R9*,0)R11* MØVE NAME INTØ TABLE                          EAD 1031
         L     R11,4)0,1*                                                   EAD 1032
         L     R11,0)0,R11*  PICK UP LENGTH ØF VARIABLE                     EAD 1033
         STH   R11,12)0,R9*  INSERT IT INTØ TABLE                           EAD 1034
         L     R11,8)0,1*    PICK UP ADDRESS ØF VARIABLE                    EAD 1035
         ST    R11,8)0,R9*   INSERT IT INTØ TABLE                           EAD 1036
         SR    R12,R12                                                      EAD 1037
         CLI   8)1*,X-80-    LEAVE IF IT WAS THE LAST ARGUMENT              EAD 1038
         BE    ALLDØNE                                                      EAD 1039
         LR    R7,1                                                         EAD 1040
         L     R11,ØNE                                                      EAD 1041
         LA    R6,14                                                        EAD 1042
LØØP     LA    R12,1)0,R12*                                                 EAD 1043
         CLI   12)R7*,X-80-  LEAVE IF THIS IS THE LAST ARGUMENT             EAD 1044
         BE    ALLDØNE                                                      EAD 1045
         C     R12,C7        LEAVE IF SEVEN SUBSCRIPTS                      EAD 1046
         BE    ALLDØNE                                                      EAD 1047
         L     R8,12)0,R7*   PICK UP DIMENSIØN                              EAD 1048
         MH    R11,2)0,R8*   CØMPUTE DIMENSIØN FACTØR                       EAD 1049
         LA    R7,4)0,R7*                                                   EAD 1050
         LA    R6,2)0,R6*                                                   EAD 1051
         STH   R11,0)R6,R9*  INSERT DIMENSIØN FACTØR INTØ TABLE             EAD 1052
         B     LØØP                                                         EAD 1054
ALLDØNE  STH   R12,14)0,R9*  INSERT NUMBER ØF SUBSCRIPTS INTØ TABLE         EAD 1055
         LA    R9,28)0,R9*   ØBTAIN LØCATIØN ØF NEXT TABLE ENTRY            EAD 1056
         ST    R9,TABLE                                                     EAD 1057
         LH    R11,NUMTAB    INCREMENT NUMBER ØF TABLE ENTRIES              EAD 1058
         LA    R11,1)0,R11*                                                 EAD 1059
         STH   R11,NUMTAB                                                   EAD 1060
         LM    R6,R12,44)13* RESTØRE REGISTERS                              EAD 1061
         BR    14            RETURN                                         EAD 1062
ERRS     L     12,AREAD      ERRØR IF WHERE NØT ENTERED BEFØRE SETUP        EAD 1063
         L     RD,AREAD,4                                                   EAD 1064
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         USING READIN,12                                               EAD 1065
         B     ERRØR1                                                  EAD 1066
         DRØP  12                                                      EAD 1067
         DS    0F                                                      EAD 1068
AREAD    DC    A(READIN*                                               EAD 1069
         DC    A(DATA*                                                 EAD 1070
         EJECT                                                         EAD 1071
*        REGISTER ASSIGNMENT                                           EAD 1072
         SPACE 2                                                       EAD 1073
RI       EQU   0                                                       EAD 1074
RA       EQU   1                                                       EAD 1075
RT       EQU   2                                                       EAD 1076
RW       EQU   3                                                       EAD 1077
RS       EQU   4                                                       EAD 1078
R5       EQU   5                                                       EAD 1079
RC       EQU   6                                                       EAD 1080
R6       EQU   6                                                       EAD 1081
R7       EQU   7                                                       EAD 1082
R8       EQU   8                                                       EAD 1083
RCMAX    EQU   9                                                       EAD 1084
R9       EQU   9                                                       EAD 1085
RD       EQU   10                                                      EAD 1086
R11      EQU   11                                                      EAD 1087
R12      EQU   12                                                      EAD 1088
         EJECT                                                         EAD 1089
*        BCD AND EBCDIC CHARACTERS                                     EAD 1090
         SPACE 2                                                       EAD 1091
BLANK    EQU   C- -                                                    EAD 1092
A        EQU   C-A-                                                    EAD 1093
D        EQU   C-D-                                                    EAD 1094
E        EQU   C-E-                                                    EAD 1095
F        EQU   C-F-                                                    EAD 1096
H        EQU   C-H-                                                    EAD 1097
N        EQU   C-N-                                                    EAD 1098
P        EQU   C-P-                                                    EAD 1099
T        EQU   C-T-                                                    EAD 1100
X        EQU   C-X-                                                    EAD 1101
Y        EQU   C-Y-                                                    EAD 1102
Z        EQU   C-Z-                                                    EAD 1103
DØLLAR   EQU   C-$-                                                    EAD 1104
STAR     EQU   C-*-                                                    EAD 1105
PLUS026  EQU   C-+-                                                    EAD 1106
PLUS029  EQU   C-.-                                                    EAD 1107
MINUS    EQU   C---                                                    EAD 1108
DECIMAL  EQU   C-.-                                                    EAD 1109
CØMMA    EQU   C-,-                                                    EAD 1110
ZERØ     EQU   C-0-                                                    EAD 1111
EQ026    EQU   C-=-                                                    EAD 1112
EQ029    EQU   C-=-                                                    EAD 1113
LP026    EQU   C-(-                                                    EAD 1114
LP029    EQU   C-)-                                                    EAD 1115
RP026    EQU   C-)-                                                    EAD 1116
RP029    EQU   C-*-                                                    EAD 1117
SLASH    EQU   C-/-                                                    EAD 1118
         EJECT                                                         EAD 1119
*        PRØGRAM DATA                                                  EAD 1120
         SPACE 2                                                       EAD 1121
DATA     DS    0D                                                      EAD 1122
CARD     DS    10D          CARD CØLUMNS 1 - 80                        EAD 1123
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CFLØAT    DC    XL8-4E00000000000000- FØR INTEGER TØ FLØATING PØINT     EAD 1124
TEN       DC    D-10-                                                   EAD 1125
TENT      DC    D-1.,1.E-1,1.E-2,1.E-3,1.E-4,1.E-5,1.E-6,1.E-7-         EAD 1126
          DC    D-1.E-8,1.E-9,1.E-10,1.E-11,1.E-12,1.E-13,1.E-14-       EAD 1127
          DC    D-1.E-15,1.E-16,1.E-17,1.E-18,1.E-19,1.E-20-            EAD 1128
DØUBLE    DS    D              THESE TWØ TEMPØRARIES MUST               EAD 1129
DB        DS    D              REMAIN CØNTIGUØUS TØ EACH ØTHER          EAD 1130
ØNE       DC    F-1-                                                    EAD 1131
TWØ       DC    F-2-                                                    EAD 1132
C7        DC    F-7-                                                    EAD 1133
NINE      DC    F-9-                                                    EAD 1134
C72       DC    F-72-                                                   EAD 1135
C8888     DC    F-8888-                                                 EAD 1136
ARGLIST   DC    A)TEN*                                                  EAD 1137
          DC    A)DB*                                                   EAD 1138
VFDXPI    DC    A)FDXPI=*                                               EAD 1139
VEXIT     DC    A)EXIT*                                                 EAD 1140
VIBCØM    DC    A)IBCØM=*                                               EAD 1141
INCØL1    DC    F-0-                                                    EAD 1142
JAN       DC    F-31,59,90,120,151,181,212,243,273,304,334,365-         EAD 1143
DATE      DS    F                                                       EAD 1144
SAVE      DS    18F                                                     EAD 1145
ADINCØL1  DS    F                                                       EAD 1146
STABLE    DC    F-0-                                                    EAD 1147
TABLE     DC    F-0-                                                    EAD 1148
NADD      DC    F-0-                                                    EAD 1149
CØL       DC    F-0-                                                    EAD 1150
CØLNØ     DC    F-0-                                                    EAD 1151
NUMSCR2   DC    F-0-                                                    EAD 1152
          LTØRG                                                         EAD 1153
CØNV      DC    H-57-                                                   EAD 1154
NUMTAB    DC    H-0-                                                    EAD 1155
NUMWD     DC    H-0-                                                    EAD 1156
NS        DC    6H-0-                                                   EAD 1157
LENGTH    DC    H-0-                                                    EAD 1158
NUMSCR    DC    H-0-                                                    EAD 1159
SUB       DS    7H                                                      EAD 1160
NMIN      DC    H-0-                                                    EAD 1161
NMAX      DC    H-0-                                                    EAD 1162
BLANKS    DC    CL8-                                                    EAD 1163
NØFLIP    DC    CL6-NØFLIP-                                             EAD 1164
FLIP      DC    CL4-FLIP-                                               EAD 1165
NØPRINT   DC    CL7-NØPRINT-                                            EAD 1166
PRINTS    DC    CL5-PRINT-                                              EAD 1167
          EJECT                                                         EAD 1168
*         FØRMAT STATEMENTS                                             EAD 1169
          SPACE 2                                                       EAD 1170
FH        DC    XL3-021A50-                                             EAD 1171
HEADING   DC    XL1-F1-                                                 EAD 1172
          DC    9CL8-                                                   EAD 1173
          DC    CL7-                                                    EAD 1174
          DC    XL1-22-                                                 EAD 1175
F1        DC    XL4-021A11F1-                                           EAD 1176
          DC    C-INPUT CARDS READ-                                     EAD 1177
          DC    XL2-1832-      50 BLANKS                                EAD 1178
          DC    XL2-1A10-      FØRMAT FØR TIME ØF DAY FIELD             EAD 1179
HRS       DS    CL2            HØURS                                    EAD 1180
          DC    CL1-.-                                                  EAD 1181
MNS       DS    CL2            MINUTES                                  EAD 1182
```

```
         DC      CL1=.=                                                    EAD 1183
SCS      DS      CL2              SECØNDS                                  EAD 1184
         DC      CL1=.=                                                    EAD 1185
HSC      DS      CL2              HUNDREDTHS ØF A SECØND                   EAD 1186
         DC      CL5=    =                                                 EAD 1187
         DC      XL2=1A08=        FØRMAT FØR DATE FIELD                    EAD 1188
MTH      DS      CL2              MØNTH                                    EAD 1189
         DC      CL1=/=                                                    EAD 1190
DAY      DS      CL2              DAY                                      EAD 1191
         DC      CL1=/=                                                    EAD 1192
YR       DS      CL2              YEAR                                     EAD 1193
         DC      XL1=22=          END ØF FØRMAT                            EAD 1194
F2       DC      XL6=02060A140822=                                         EAD 1195
F3       DC      XL3=021A06=                                               EAD 1196
         DC      CL6= DATA*=                                               EAD 1197
         DC      XL6=060A14081A05=                                         EAD 1198
         DC      CL5=*DATA=                                                EAD 1199
         DC      XL1=22=                                                   EAD 1200
FE2      DC      XL3=021A1E=                                               EAD 1201
         DC      CL13=0 NØ SYMBØL ==                                       EAD 1202
NAME     DC      CL8=        =                                             EAD 1203
         DC      CL9== LISTED.=                                            EAD 1204
         DC      XL1=22=                                                   EAD 1205
FE1      DC      XL3=021A44=                                               EAD 1206
         DC      CL32=0 WHERE NØT ENTERED BEFØRE SETUP=                    EAD 1207
         DC      CL36= ØR SETUP NØT ENTERED BEFØRE READIN.=                EAD 1208
         DC      XL1=22=                                                   EAD 1209
FE       DC      XL3=021A1F=                                               EAD 1210
         DC      CL31=0 ERRØR IN FØRMAT ØN LAST CARD.=                     EAD 1211
         DC      XL1=22=                                                   EAD 1212
         END                                                               EAD 1213
```

```
UPRESET DATA                                                                PRESE  1
      ERRRTB   0.  2.26D-6   1.7D-5  4.26D-5  1.112D-4  .00033             PRESE  2
      .001068    .01171   .0804   1000000.                                  PRESE  3
      ERNUTB   0.  10.   14.  18.  22.   26.   30.   1000000.               PRESE  4
      ERNTBL                                                                PRESE  5
       (1,01)1   100.  1.15D6 4.0D9  2.1D11 7.D11 1.3D12  2.D12  2.D12      PRESE  6
       (1,02)1   100.  1.15D6 4.0D9  2.1D11 7.D11 1.3D12  2.D12  2.D12      PRESE  7
       (1,03)1   100.  2.00D6 2.0D10 7.2D11 3.1D12 7.2D12 1.0D13 1.0D13     PRESE  8
       (1,04)1   100.  4.30D7 1.0D11 3.5D12 1.5D13 4.0D13 7.0D13 7.0D13     PRESE  9
       (1,05)1   100.  6.70D8 7.7D11 2.0D13 8.8D13 2.1D14 3.5D14 3.5D14     PRESE 10
       (1,06)1   100.  1.2D10 9.2D12 1.7D14 7.4D14 1.8D15 3.0D15 3.0D15     PRESE 11
       (1,07)1   100.  6.0D11 1.1D14 1.9D15 7.0D15 1.8D16 2.8D16 2.8D16     PRESE 12
       (1,08)1   100.  2.3D12 8.1D14 1.4D16 5.4D16 1.5D17 2.2D17 2.2D17     PRESE 13
       (1,09)1   100.  1.4D13 5.0D15 9.1D16 3.6D17 1.0D18 2.0D18 2.0D18     PRESE 14
       (1,10)1   100.  1.4D13 5.0D15 9.1D16 3.6D17 1.0D18 2.0D18 2.0D18     PRESE 15
       RSTABL .0 1.E-6 1.E-5  1.E-4  1.E-3  1.E-2  ,1 1.      100.          PRESE 16
      HSTABL 0. 30.(20.)450.  470.  1.E10                                   PRESE 17
       ERTABL                                                               PRESE 18
  (1,9)1  0.0  0.72E9  0.25E14  0.20E15  0.78E16  0.35E17  0.13E18          PRESE 19
 0.34E18  0.62E18  0.90E18  0.14E19  0.17E19  0.21E19  0.25E19  0.36E19    PRESE 20
 0.39E19  0.47E19  0.56E19  0.63E19  0.70E19  0.86E19  0.20E19             PRESE 21
 0.12E20  0.14E20  0.14E20                                                  PRESE 22
    (1,8)1  0.                                                              PRESE 23
           0.72E7  0.25E12  0.20E13  0.78E14  0.35E15  0.13E16  0.34E16     PRESE 24
 0.62E16  0.90E16  0.14E17  0.17E17  0.21E17  0.25E17  0.36E17  0.38E17    PRESE 25
 0.47E17  0.56E17  0.63E17  0.70E17  0.86E17  0.20E17  0.12E18             PRESE 26
 0.14E18  0.14E18                                                           PRESE 27
   (1,7)1  0.                                                               PRESE 28
           0.45E7  0.48E11  0.91E12  0.56E13  0.29E14  0.14E15  0.34E15     PRESE 29
 0.54E15  0.90E15  0.12E16  0.14E16  0.17E16  0.21E16  0.24E16  0.28E16    PRESE 30
 0.37E16  0.42E16  0.46E16  0.57E16  0.72E16  0.83E16  0.94E16             PRESE 31
 0.14E17  0.14E17                                                           PRESE 32
    (1,6)1  0.                                                              PRESE 33
           0.19E7  0.43E10  0.60E11  0.37E12  0.27E13  0.13E14  0.30E14     PRESE 34
 0.46E14  0.68E14  0.86E14  0.10E15  0.13E15  0.15E15  0.17E15  0.20E15    PRESE 35
 0.26E15  0.28E15  0.34E15  0.38E15  0.52E15  0.62E15  0.72E15  0.10E16    PRESE 36
 0.10E16                                                                    PRESE 37
     (1,5)1  0.                                                             PRESE 38
           0.58E6  0.15E8  0.28E10  0.23E11  0.26E12  0.13E13  0.24E13      PRESE 39
 0.35E13  0.50E13  0.62E13  0.76E13  0.94E13  0.10E14  0.12E14             PRESE 40
 0.14E14  0.16E14  0.19E14  0.24E14  0.28E14  0.33E14  0.45E14             PRESE 41
 0.59E14  0.74E14  0.74E14                                                  PRESE 42
   (1,4)1  0.                                                               PRESE 43
           0.92E5  0.16E8  0.16E9  0.14E10  0.32E11  0.10E12                PRESE 44
 0.19E12  0.27E12  0.36E12  0.44E12  0.53E12  0.60E12  0.74E12             PRESE 45
 0.89E12  0.97E12  0.11E13  0.13E13  0.15E13  0.23E13  0.26E13  0.35E13    PRESE 46
 0.39E13  0.45E13  0.45E13                                                  PRESE 47
    (1,3)1  0.                                                              PRESE 48
           0.52E4  0.94E6  0.60E7  0.12E9  0.31E10  0.82E10  0.14E11        PRESE 49
 0.19E11  0.27E11  0.31E11  0.40E11  0.44E11  0.51E11  0.59E11  0.68E11    PRESE 50
 0.80E11  0.95E11  0.12E12  0.16E12  0.20E12  0.25E12  0.28E12             PRESE 51
 0.42E12  0.42E12                                                           PRESE 52
    (1,2)1  0.                                                              PRESE 53
           0.80E3  0.42E5  0.32E6  0.25E7  0.32E9  0.71E9  0.11E10          PRESE 54
 0.15E10  0.18E10  0.23E10  0.27E10  0.31E10  0.42E10  0.52E10  0.60E10    PRESE 55
 0.78E10  0.90E10  0.12E11  0.14E11  0.17E11  0.24E11  0.29E11  0.33E11    PRESE 56
 0.33E11                                                                    PRESE 57
      (2-30,1)  0.                                                          PRESE 58
      EXCTBL  1. 3.(3.)30.  1.E6                                            PRESE 59
      THTTBL  0. 2.(4.)30.  45.  1.E6                                       PRESE 60
```

```
 [illegible]TABL                                                         PRESE 61
(1,1)1  1.0  3.0  6.0  9.0  12.0  15.0  18.0  21.0  24.0  27.0          PRESE 62
30.0  100.0                                                             PRESE 63
(1,2)1  1.13  3.11  6.30  9.64  13.1  16.8  20.6  24.6  28.8  33.4      PRESE 64
38.  100.0                                                              PRESE 65
(1,3)1  1.29  3.33  7.00  11.2  16.2  22.0  29.0  37.7  48.6  63.0      PRESE 66
81.0  100.0                                                             PRESE 67
(1,4)1  1.43  3.58  7.84  13.4  21.0  33.4  49.2  80.0  100.0           PRESE 68
[illegible].0  100.0  100.0                                             PRESE 69
(1,5)1  1.57  3.85  8.89  16.7  29.8  58.0  100.0  100.0  100.0         PRESE 70
[illegible].0  100.0  100.0                                             PRESE 71
(1,6)1  1.70  4.15  10.2  21.8  51.0  100.0  100.0  100.0  100.0        PRESE 72
[illegible]  100.0  100.0                                               PRESE 73
(1,7)1  1.84  4.49  12.0  31.6  100.0  100.0  100.0  100.0              PRESE 74
[illegible].0  100.0  100.0  100.0                                      PRESE 75
(1,8)1  2.00  4.88  14.6  53.0  100.0  100.0  100.0  100.0  100.0       PRESE 76
[illegible]  100.0  100.0                                               PRESE 77
(1,9)1  2.13  5.32  18.4  100.0  100.0  100.0  100.0  100.0  100.0      PRESE 78
[illegible]  100.0  100.0                                               PRESE 79
(1,10)1  2.76  7.79  100.0  100.0  100.0  100.0  100.0  100.0  100.0    PRESE 80
[illegible]  100.0  100.0                                               PRESE 81
(1,11)1  100.0  100.0  100.0  100.0  100.0  100.0  100.0  100.0         PRESE 82
100.0  100.0  100.0  100.0                                              PRESE 83
     XDTABL  .0000001  .01  .03  .1  1.E6                               PRESE 84
     YDTABL  0.  15.  20.(20.)160.  1.E6                                PRESE 85
     ZDTABL  0.  .01  .1  1.                                            PRESE 86
  DTABL                                                                 PRESE 87
(1,5,1)1  0.0  0.70E1  0.38E3  0.32E10  0.25E12  0.32E13  0.17E14       PRESE 88
[illegible]  0.24E15  0.44E15  0.44E15                                  PRESE 89
(1,4,1)1  0.0  0.50E1  0.38E3  0.32E10  0.25E12  0.32E13  0.17E14       PRESE 90
[illegible]  0.24E15  0.44E15  0.44E15                                  PRESE 91
(1,3,1)1  0.0  0.32E2  0.12E4  0.11E10  0.78E11  0.10E13  0.65E13       PRESE 92
[illegible]  0.87E14  0.16E15  0.16E15                                  PRESE 93
(1,2,1)1  0.0  0.95E2  0.30E4  0.20E9  0.05E11  0.14E12  0.20E13        PRESE 94
[illegible]  0.22E14  0.38E14  0.38E14                                  PRESE 95
(1,1,1)1  0.0  0.90E2  0.30E4  0.20E9  0.05E11  0.14E12  0.20E13        PRESE 96
[illegible]  0.22E14  0.38E14  0.38E14                                  PRESE 97
(1,5,2)1  0.0  1.0E5  3.5E7  2.0E11  1.3E12  2.0E12  4.5E12  1.4E13     PRESE 98
[illegible]  3.0E13  4.0E13                                             PRESE 99
(1,4,2)1  0.0  1.0E5  3.5E7  2.0E11  1.3E12  2.0E12  4.5E12  1.4E13     PRESE100
2.[illegible]  3.0E13  4.0E13                                           PRESE101
(1,3,2)1  0.0  5.5E4  1.9E7  1.1E11  2.3E11  4.5E11  2.0E12  5.0E12     PRESE102
[illegible]  1.5E13  2.5E13                                             PRESE103
(1,2,2)1  0.0  2.0E4  7.0E6  4.0E10  1.6E11  2.0E11  6.0E11  1.4E12     PRESE104
[illegible]  3.0E12  4.0E12                                             PRESE105
(1,1,2)1  0.0  2.0E4  7.0E6  4.0E10  1.6E11  2.0E11  6.0E11  1.4E12     PRESE106
2.[illegible]  3.0E12  4.0E12                                           PRESE107
(1,5,3)1  0.0  2.4E5  1.5E8  7.6E11  5.6E11  1.3E13  1.6E13  2.1E13     PRESE108
3.[illegible]  4.0E13  4.5E13                                           PRESE109
(1,4,3)1  0.0  2.4E5  1.5E8  7.6E11  5.6E12  1.3E13  1.6E13  2.1E13     PRESE110
3.[illegible]  4.0E13  4.5E13                                           PRESE111
(1,3,3)1  0.0  1.2E5  7.1E7  3.7E11  2.4E12  5.8E12  6.2E12  7.7E12     PRESE112
1.[illegible]  1.5E13  2.0E13                                           PRESE113
(1,2,3)1  0.0  4.5E4  2.7E7  1.4E11  7.1E11  1.7E12  1.7E12  2.0E12     PRESE114
2.7[illegible]  3.5E12  4.0E12                                          PRESE115
(1,1,3)1  0.0  4.5E4  2.7E7  1.0E11  7.1E11  1.7E12  1.7E12  2.0E12     PRESE116
2.7E12  3.5E12  4.0E12                                                  PRESE117
(1,5,4)1  0.0  7.0E5  2.3E8  2.0E12  1.8E13  6.0E13  1.4E14  1.3E14     PRESE118
1.[illegible]  1.5E14  2.0E14                                           PRESE119
```

```
(1,4,4)1  0.0  7.9E5  2.3E8  2.0E12  1.8E13  6.0E13  1.4E14  1.3E14     PRESE120
1.2E14  1.5E14  2.0E14                                                  PRESE121
(1,3,4)1  0.0  5.2E5  1.5E8  1.3E12  8.0E12  3.0E13  5.7E13  5.2E13     PRESE122
4.7E13  5.0E13  6.0E13                                                  PRESE123
(1,2,4)1  0.0  1.7E5  5.0E7  4.3E11  2.5E12  1.1E13  1.5E13  1.3E13     PRESE124
1.2E13  1.3E13  2.0E13                                                  PRESE125
(1,1,4)1  0.0  1.7E5  5.0E7  4.3E11  2.5E12  1.1E13  1.5E13  1.3E13     PRESE126
1.2E13  1.3E13  2.0E13                                                  PRESE127
CNUMB(1)  0.02  2.0  1.0  0.0  0.5                                      PRESE128
CNUMB(59)  0.66  1.2 (64)  0.0  0.0  0.25  0.5                          PRESE129
(83)  4.4E26  0.0  1.0  0.0  1.0  0.0  1.0                              PRESE130
(99)  1.0  6.3246E14  0.0  1.0 (100)  0.0 (115)  1.0E11                 PRESE131
(116)  1000.0  1.0  1.0  1.0E3  0.0  0.0  1.0                           PRESE132
(123)  5.0E-12  -1.5  1.0 (130)  1.0  0.0  1.0  0.0  2.0  1.0E-10  0.0 PRESE133
(159)  0.66  120.0 (164)  0.04  86.0 (169)  1.0                         PRESE134
ACON 1.                                                                 PRESE135
AKU  50.                                                                PRESE136
BCON 1.                                                                 PRESE137
B21 1.                                                                  PRESE138
B22 .25                                                                 PRESE139
B23 0.0                                                                 PRESE140
CCON 1.                                                                 PRESE141
CRHOW .75                                                               PRESE142
  DELWT .01 DHCHEM 0.0                                                  PRESE143
RHOSL .08042                                                            PRESE144
RHOW 115.                                                               PRESE145
RT  8.475D5                                                             PRESE146
TABL 15.0.                                                              PRESE147
BZERO  5.8E-21 B2  4.0E-10 B3  2.0 BTWEN  1.0 B24  1.0E-26              PRESE148
DX  50.0 NSTWL  100 ZNUS  2.0E11 CNE  0.0 DSD  0.0 X2BOD  0.0 X3B  0.0 PRESE149
IND2  0 IWPRNT  0 IND  0 IWAKE  2 WKALT  500000.0  0.0 IDBL  4          PRESE150
[illegible]TAZ  22.0  22.0 PHI1 6.0  6.0 PHI2  6.0  6.0 PHI3  6.0  6.0  PRESE151
[illegible]  4.35E8 FRQ2  1.375E9 FRQ3  5.4E9 SIGNL1  1.0E-6             PRESE152
[illegible]L2  1.0E-6 SIGNL3  1.0E-6 TAU1  1.0 TAU2  0.4 TAU3  0.4      PRESE153
[illegible]ALT  1800[illegible].0 XCOM(7)  1.0 ICOM(4)  1  1  1 ACOE  1.0 PFD  0.03  PRESE154
[illegible](1-9)  40.0                                                  PRESE155
  [illegible](22-9[illegible]) 0                                         PRESE156
  [illegible](7) 136 135 134 XCOM(8) 1.0                                 PRESE157
  [illegible](76) = 1                                                    PRESE158
[illegible] OF THE PRESET INPUT DECK
```

NOT REPRODUCIBLE

APPENDIX II - Overlay Information and Other Pertinent Information for running the Optimum Decoy Design Program

SET UP OF BINARIES FOR THE OVERLAY

Program 2542 has been run successfully on the OS65 at Avco using version 14 of the operating system.

All binaries whose names do not follow one of the OVERLAY cards should be first in order in the binary deck.

These binaries should then be followed by the following six overlay segments. The names of the binaries included in a particular segment follow the overlay card for that segment.

OVERLAY A1

READIT
SR2490
ZPRM
ZPRS
ZREADX

OVERLAY A1

VIXEN

OVERLAY A1

ADD
INFCØF
INTGRL
WRITEM

OVERLAY A2

DAVDØN

READY

OVERLAY A2

GIMAX

MIMAX

OVERLAY A2

GRAM

RØSBRK

OTHER INFORMATION

1.0 A Preset Deck is needed to run the program.

2.0 The subroutine LA000000 is written in Assembly Language.

3.0 The input quantity IØP(76) should be set to 1 at AVCO and to 0 at Aerospace.

4.0 The dummy subroutine PLT must be removed at Aerospace.

5.0 The dummy subroutines ENDJØB, EZPLØT, FRAMEV, IDFRMV, and PLTND must be removed at AVCO.